

PART-I PHYSICS

1. A nucleus of mass $4m$ disintegrates into two daughter nuclei of mass m and $3m$. Find the ratio of their respective De-Broglie wavelength?

- (a) $\lambda_{e^-} > \lambda_{p^+} > \lambda_{\alpha}$ (b) $\lambda_{p^+} > \lambda_{\alpha} > \lambda_{e^-}$
 (c) $\lambda_{\alpha} > \lambda_{p^+} > \lambda_{e^-}$ (d) $\lambda_{e^-} > \lambda_{\alpha} > \lambda_{p^+}$

2. Earth moves around sun in elliptical orbit. If minimum and maximum distance between earth and sun are $r_{\min}$ and $r_{\max}$ respectively and minimum and maximum speed of earth are $V_{\min}$ and $V_{\max}$ respectively. Express $V_{\max}$ in terms of others parameters.

- (a) $v_{\max} = \frac{r_{\min} v_{\min}}{r_{\max}}$ (b) $v_{\max} = \frac{r_{\max} v_{\min}}{r_{\min} + r_{\max}}$
 (c) $v_{\max} = \frac{r_{\max} v_{\min}}{r_{\min}}$ (d) $v_{\max} = v_{\min}$

3. In an amplitude modulator circuit, the carrier wave is given by,

$C(t) = 4\sin(2\pi \times 10^7 t)$ while modulating signal is given by, $m(t) = 2\sin(2\pi \times 10^5 t)$. Then the bandwidth of the broadcast signal will be

- (a) 0.2MHz (b) 2MHz
 (c) 20MHz (d) 40MHz

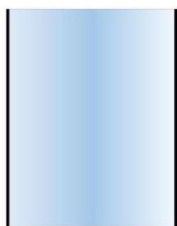
4. Find the ratio of the impulse transferred to the wall by a ball incident normally and then at 45° with normal?

- (a) 1:2 (b) $\sqrt{2}:1$
 (c) $1:\sqrt{2}$ (d) 2:1

5. The electrical permittivity of dielectric varies with x as:

$$\epsilon = \epsilon_0 \left[1 + \frac{kx}{d} \right]; 0 \leq x \leq \frac{d}{2}$$

$$= \epsilon_0 \left[1 + \frac{k(d-x)}{d} \right]; \frac{d}{2} \leq x \leq d$$



If the area of the plates is A then find capacitance of capacitor.

- (a) $\frac{k\epsilon_0 A}{2d}$ (b) $\frac{k\epsilon_0 A}{2d} \ln \left[1 + \frac{k}{2} \right]$
 (c) $\frac{k\epsilon_0 A}{2d} \ln \left[2 + \frac{k}{2} \right]$ (d) $\left(1 + \frac{k}{2} \right) \frac{\epsilon_0 A}{2}$

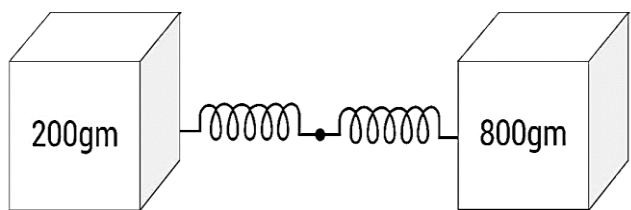
6. A particle tied to string of length 0.5 m is given a velocity 3 ms^{-1} at its bottom point while undergoing vertical circular motion. What will be its speed when it makes an angle of 60° with the lower vertical?

- (a) 1.5 m/s (b) 2.5 m/s
(c) $2\sqrt{2}$ m/s (d) 2 m/s

7. Half life time of Gold is 3 days. Find the activity of a sample of 2mg of Gold. Options:

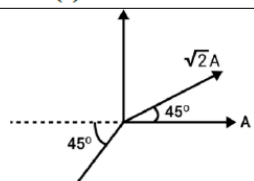
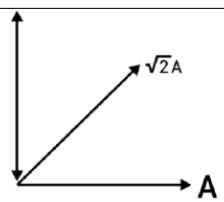
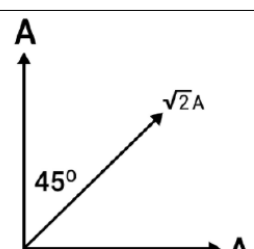
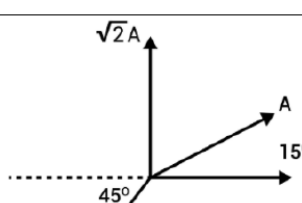
- (a) 85 curie (b) 594 curie
(c) 441 curie (d) 121 curie

8. Two springs having constant, k and $4k$ are connected in series and then connected to 2 masses, 200gm and 800gm at each end. Find angular frequency of their oscillation if $k = 20 \text{ N/m}$.



- (a) 10rad/sec (b) 20rad/sec
(c) 5rad/sec (d) 40rad/sec

9. In column (I) different orientation of 3 vectors are given and in column (II) magnitude of resultant of vectors is given

Column (I)	Column (I)
 (P)	A
 (Q)	Zero
 (R)	2A
 (S)	$2\sqrt{2}A$

- (a) $P \rightarrow 1, Q \rightarrow 2, R \rightarrow 3, S \rightarrow 4$
 (b) $P \rightarrow 2, Q \rightarrow 3, R \rightarrow 4, S \rightarrow 1$
 (c) $P \rightarrow 2, Q \rightarrow 3, R \rightarrow 1, S \rightarrow 4$
 (d) $P \rightarrow 3, Q \rightarrow 2, R \rightarrow 4, S \rightarrow 1$

10. If position vector of a particle is given by: $\vec{r} = 10at^2\hat{i} + [5\beta t - 5]\hat{j}$ Find time when its angular momentum about origin is 0.

- (a) β (b) $\frac{1}{\beta}$
 (c) $\frac{2}{\beta}$ (d) $\frac{\beta}{2}$

11. Two wires of equal dimensions and Young's modulus Y_1 and Y_2 are connected end to end. What is the equivalent Young's modulus for the combination?

- (a) $\frac{Y_1 + Y_2}{2}$ (b) $\sqrt{Y_1 Y_2}$
 (c) $\frac{2Y_1 Y_2}{(Y_1 + Y_2)}$ (d) $\sqrt{\frac{Y_1^2 Y_2^2}{2}}$

12. A bulb rated 200W, 100 V is connected to 200 V supply. What external resistance should be connected in series to have same power as earlier?

- (a) 100Ω (b) 50Ω
(c) 10Ω (d) 5Ω

13. Water drops are coming out of a tap at constant rate. A falling drop is observed at 4th second after fall. Distance between that drop and next drop is 34.3 m. Find the rate of water drops coming out of tap (drops/sec) [$g = 9.8 \text{ m/s}^2$]

- (a) 2 (b) 1
(c) 1.5 (d) 3

14. In a potentiometer setup, EMF of primary cell is 6 V and internal resistance is 20Ω . The potentiometer wire is of length 10 m having $0.1\Omega/\text{cm}$. This setup is used to find EMF of a cell which is balanced at 5.5 m mark. Find EMF of the cell.

- (a) 2.75 V (b) 2.25 V
(c) 2.5 V (d) 3 V

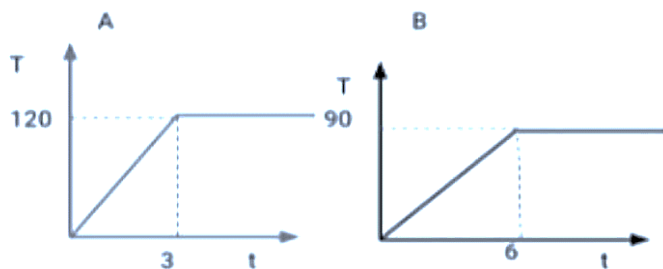
15. A nucleus of mass 4 m disintegrates into two daughter nuclei of mass m and 3 m. Find the ratio of their respective De Broglie wavelength?

- (a) 1:3 (b) 3:1
(c) $1:\sqrt{3}$ (d) 1:1

16. In a YDSE setup, the distance between the slits varies as $d = d_0 + A \sin \omega t$. What is the difference between the maximum and minimum fringe width?

- (a) $\frac{2\lambda AD}{d_0^2}$ (b) $\frac{2\lambda AD}{d_0^2 - A^2}$
(c) $\frac{2\lambda AD}{d_0^2 + A^2}$ (d) $\frac{2\lambda d_0 D}{d_0^2 - A^2}$

17. Temperature vs time graphs are given below for 2 substances. Compare specific heat capacity.

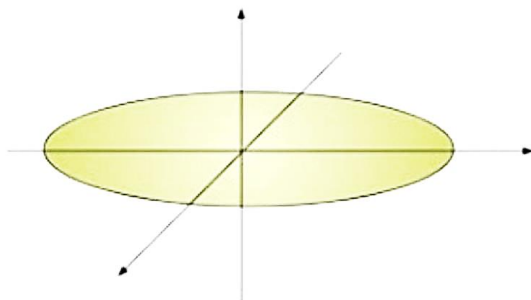


- (a) $S_A > S_B$ (b) $S_B > S_A$
(c) $S_A = S_B$ (d) Can't be determined

18. x and y are the axes along the diameter of a disk of mass m and radius R. z-axis is perpendicular to plane of the disk.

Assertion: Radius of gyration is same about all three axes.

Reason: All axes are symmetry axes.



- (a) Assertion and Reason both are correct and Reason is correct explanation for assertion
- (b) Assertion and Reason both are correct but Reason doesn't explain assertion
- (c) Assertion is right and Reason is wrong
- (d) Assertion is wrong and Reason is right

19. A ball of mass 2 kg moving with 4 m/s collides elastically with a stationary ball. If it continues to move in original direction with $\frac{1}{4}$ of its original velocity. Find velocity of centre of Mass of system.

- (a) 3 m/s
- (b) $\frac{2}{5}$ m/s
- (c) $\frac{5}{2}$ m/s
- (d) 2 m/s

20. A gas has $C_p - C_v = R$ at temperature $T = P$ and $C_p - C_v = 1.1R$ at temperature $T = Q$. Then

- (a) $P = Q$
- (b) $P > Q$
- (c) $P < Q$
- (d) None of these

PART-II CHEMISTRY

21. Which of the following gives CO_2 on reaction with NaHCO_3 ?

- (a) $(\text{CH}_3)_4\text{N}^+\text{OH}^-$
- (b) CH_3NH_2
- (c) Benzene Diazonium + HCl
- (d) Acetic acid

22. Which of the following do not exist?

- (a) SiF_6^{2-}
- (b) GeCl_6^{2-}
- (c) $\text{Sn}(\text{OH})_6^{2-}$
- (d) SiCl_6^{2-}

23. Which of the following give para Bromination on phenol as a major product?

- (a) $\text{Br}_2/\text{FeBr}_3$
- (b) CS_2/Br_2
- (c) $\text{CHCl}_3/\text{Br}_2$
- (d) Bromine water

24. Which of the following is water soluble protein?

- (a) Albumin (b) Collagen
(c) Myosin (d) Fibrin

25. Which of the following is leached out from the extraction of Al from Bauxite? Options:

- (a) Al_2O_3 (b) Al
(c) AlN (d) Al_2S_3

26. In the complete combustion of Butane, 72 g of water is given out. How much Butane was there?

- (a) 50 g (b) 54 g
(c) 46.4 g (d) 44.6 g

27. Assertion (A): Primary aromatic amine cannot be Gabriel phthalimide reaction.

Reason (R): Primary aromatic amine cannot be produced by nucleophilic substitution reaction

- (a) A - Both A and R are true and R is the correct explanation of A
(b) B - Both A and R are true but R is not the correct explanation of A
(c) C - A is true but R is false
(d) D - A is false but R is true

28. Arrange the following in the increasing order of oxidation state: CrO_3 , V_2O_5 , MnO_2 , Fe_2O_3

- (a) $\text{Fe}_2\text{O}_3 < \text{MnO}_2 < \text{V}_2\text{O}_5 < \text{CrO}_3$
(b) $\text{MnO}_2 < \text{Fe}_2\text{O}_3 < \text{CrO}_3 < \text{V}_2\text{O}_5$
(c) $\text{Fe}_2\text{O}_3 < \text{MnO}_2 < \text{CrO}_3 < \text{MnO}_2$
(d) $\text{MnO}_2 < \text{Fe}_2\text{O}_3 < \text{CrO}_3 < \text{Fe}_2\text{O}_3$

29. Which of the following is not used in dry-cleaning?

- (a) H_2O_2 (b) CCl_4
(c) CO_2 (d) C_2Cl_4

30. S1: None of the alkaline earth metal hydroxide are soluble in alkaline solution S2: The solubility of alkaline earth metal hydroxide decreases down the group. True or False type

- (a) Both S1 and S2 are true (b) Both S1 and S2 are false
(c) S1 is true but S2 is false (d) S1 is false but S2 is true

31. Which of the following complexes show attraction in external magnetic field? Options:

- (a) $\text{Co}(\text{CN})_6^{3-}$ (b) $\text{Ni}(\text{CO})_4$



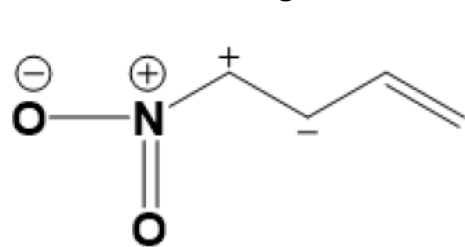
32. Decreasing order of ionic radii: Al^{3+} ; K^+ ; Na^+ ; Mg^{2+}

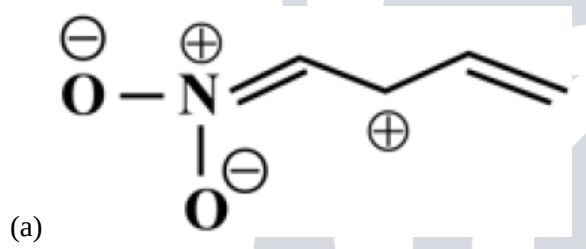
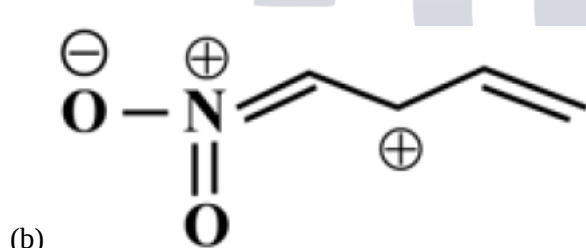
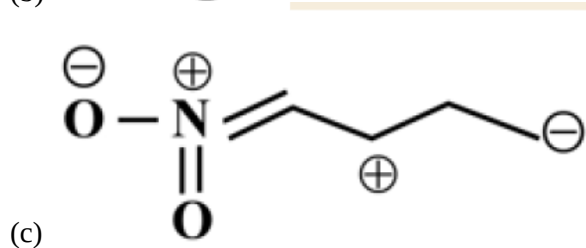
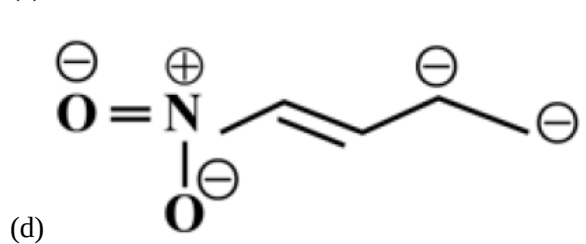
- (a) $\text{K}^+ > \text{Na}^+ > \text{Mg}^{2+} > \text{Al}^{3+}$
 (b) $\text{Na}^+ > \text{K}^+ > \text{Mg}^{2+} > \text{Al}^{3+}$
 (c) $\text{Mg}^{2+} > \text{Na}^+ > \text{Al}^{3+} > \text{Mg}^{2+}$
 (d) $\text{Al}^{3+} > \text{K}^+ > \text{Mg}^{2+} > \text{Na}^+$

33. Number of sigma bonds in $\text{CH}_3\text{CH}=\text{CH}-\text{C}\equiv\text{CH}$

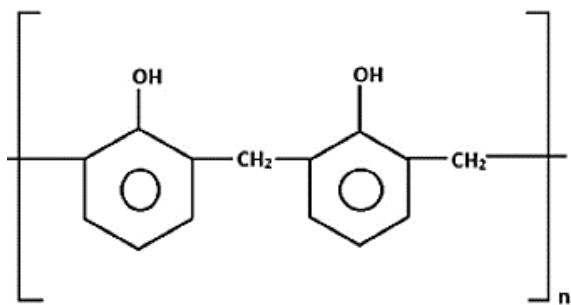
34. Empirical formula of an octahedral complex is $\text{CrCl}_3 \cdot 3\text{NH}_3 \cdot 3\text{H}_2\text{O}$. It precipitates 3 moles of AgCl . Find the secondary valency of the central atom.

35. Correct resonating structure of the given structure



- (a) 
- (b) 
- (c) 
- (d) 

36. Identify the polymer.



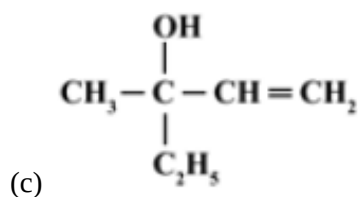
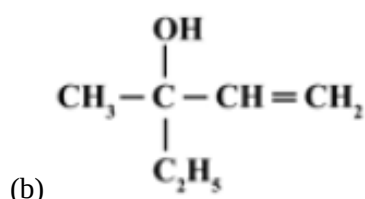
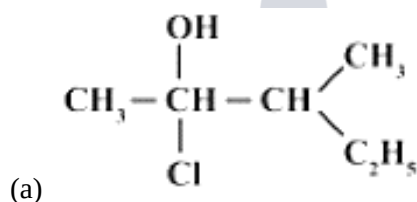
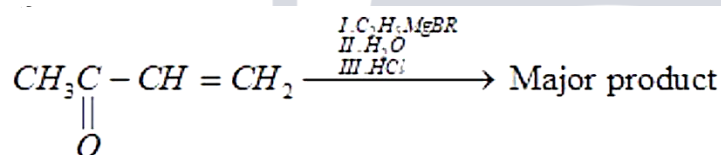
- (a) Novalac (b) Neoprene
(c) Buna N (d) Nylon

37. X Solid gets converts into X liquid, X liquid gets converts into X gas . Enthalpy of fusion of solid X = 2.8 kJ/mol, and enthalpy of vaporization of X = 98.2 kJ/mol, The enthalpy of sublimation is:

38. Bond dissociation enthalpy of H(E_H) and bond dissociation enthalpy of deuterium (ED_D) are related as:

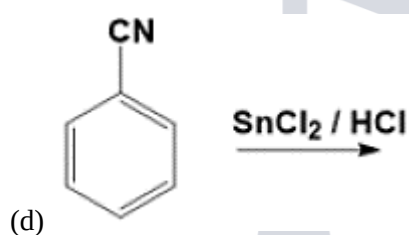
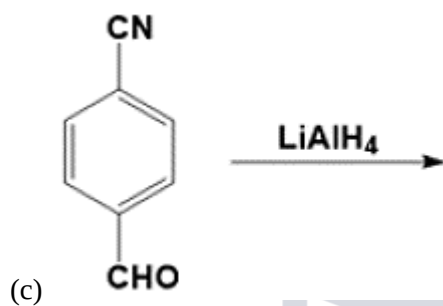
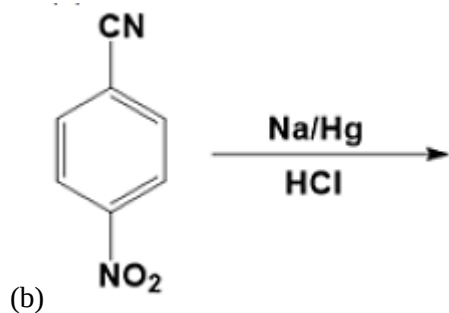
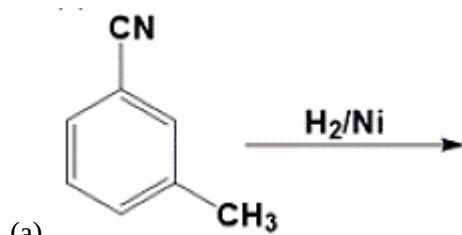
- (a) $E_H = E_D$ (b) $E_H = 1/2 E_D$
(c) $E_H = 2 E_D$ (d) $E_H \sim E_D - 7.5$

39.



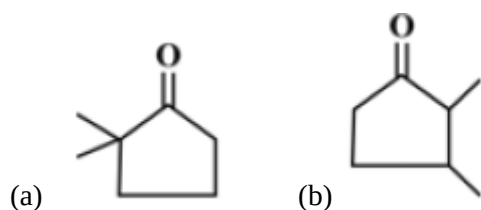
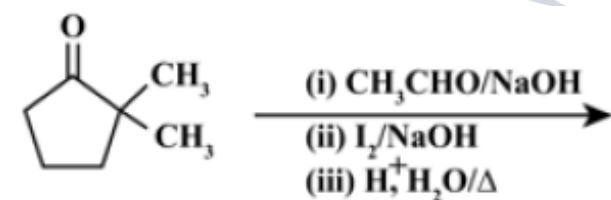
- (d) None of these

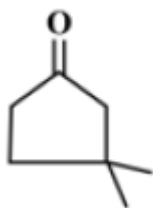
40. Product of which of the following reaction will not give Hinsberg reagent?



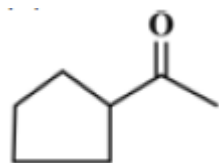
41. Fe^{2+} reacts with $\text{K}_2\text{Cr}_2\text{O}_7$ in acidic medium. Volume of $\text{Fe}^{2+} = 10\text{ml}$, Volume of $\text{K}_2\text{Cr}_2\text{O}_7 = 15\text{ml}$. molarity of $\text{K}_2\text{Cr}_2\text{O}_7 = 0.1\text{M}$ Find the molarity of Fe^{2+}

42.





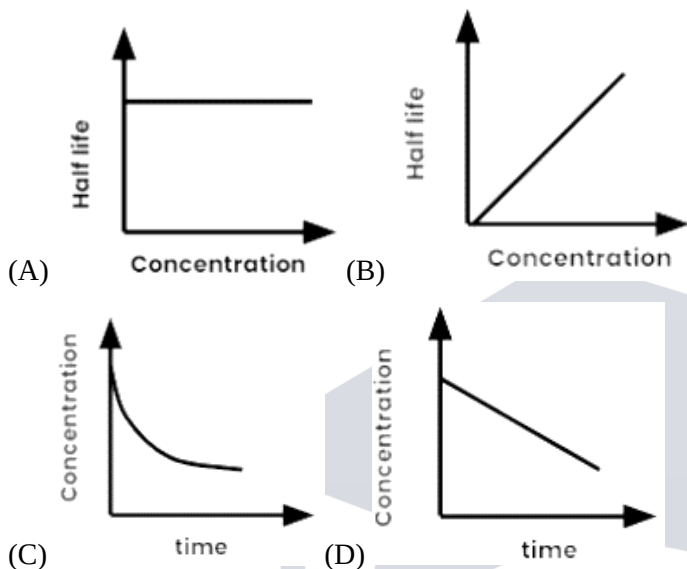
(c)



(d)

43. $A + B \rightleftharpoons 2C$ Concentration of $A = B = C$ (initially) . If $K_c = 100$, find concentration C at equilibrium?

44. Select the correct option for the given graph:



- (a) A, C = first order & B, D = 0 order
 (b) B, D = first order & A, C = 0 order
 (c) All are first order
 (d) All are zero order

PART-III MATHEMATICS

45. $I = \int_{\frac{\pi}{24}}^{\frac{5\pi}{24}} \frac{dn}{1 + \sqrt[3]{\tan 2x}}$

- (a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$
 (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{12}$

46. For a parabola, it's vertex is at a distance of 2 units from origin, focus is at distances of 4 units from origin. A pair of tangents are drawn from origin to the parabola which meet it at P and Q. Find area of $\triangle OPQ$ (O: origin).

- (a) 16 (b) 32
 (c) $16\sqrt{2}$ (d) $32\sqrt{2}$

47. If $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ ellipse passes through $\left(\sqrt{\frac{3}{2}}, 1\right)$, $e = \frac{1}{\sqrt{3}}$. Circle centred at one of the focus and radius $\frac{2}{\sqrt{3}}$. These ellipse & circle intersect at two points. Find square of the distance between the two points.

- (a) $\frac{4}{3}$ (b) $\frac{2}{3}$
(c) $\frac{16}{3}$ (d) $\frac{32}{3}$

48. $(p \rightarrow q) \wedge (q \rightarrow \sim p)$ is equivalent to

- (a) $\sim p$ (b) p
(c) $\sim q$ (d) q

49. $\sin x + \sin 2x + \sin 3x + \sin 4x = 0$. Find sum of roots that lying in $[0, 2\pi]$ Options:

- (a) 8π (b) 9π
(c) 11π (d) 12π

50. In An A.P., $S_{3n} = 3S_{2n}$. Find $\frac{S_{4n}}{S_{2n}}$.

- (a) 2 (b) 4
(c) 6 (d) 8

51. $\frac{1}{a-b} + \frac{1}{a-2b} + \frac{1}{a-3b} + \dots + \frac{1}{a-nb} = \alpha \cdot n + \beta \cdot n^2$, $\frac{b}{a}$ is small such that $\left(\frac{b}{a}\right)^3$ & other higher powers are neglected. Then find r .

- (a) $\frac{b^2}{3a^3}$ (b) $\frac{b^2+a}{3a^2}$
(c) $\frac{b^2}{4a^3}$ (d) $\frac{b^2}{5a^3}$

52. If the coefficient middle term of $(1+x)^{20}$ is A and the coefficient of middle terms of $(1+x)^{19}$ are B and C then find $\frac{A}{B+C}$

53. In class 12 there are 8 students, In class 11 there are 6 students, In class 10 there are 5 students. The probability of selecting 10 students, such that there are at least 2 students from each class and at most 5 students from 11 students of class 10&11 combined is $100k$. Find k

54. Find the locus of centroid formed by any point P & foci of hyperbola.

$$16x^2 - 9y^2 + 32x + 36y - 164 = 0.$$

55. Let $S = \left\{ n \in N, \begin{bmatrix} 0 & i \\ i & 0 \end{bmatrix}^n \begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \forall a, b, c, d \in R \right\}$. Find number of 2-digit numbers in S

56. If $\left(1 + \frac{2}{3} + \frac{6}{3^2} + \frac{10}{3^3} + \dots \infty\right)^{\log_{(0.25)}\left(\frac{1}{3} + \frac{1}{3^2} + \frac{1}{3^3} + \dots \infty\right)} = l$ then find l^2

57. If $\left[\frac{x+1}{x^{\frac{2}{3}+1-x^{\frac{1}{3}}}} - \frac{x-1}{(x+\sqrt{x})} \right]^{10}$. Find term independent of x .

58. $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, $a, b, c, d \in \{3, -3, -2, 2, 1, -1, 0\}$, $f(A) = \det(A)$. Find probability that $f(A) = 15$.

59. $\vec{p} = (3\hat{i} + 2\hat{j} + \hat{k})$, $\vec{q} = (2\hat{i} + \hat{j} + \hat{k})$, $\vec{r}$ is perpendicular to both $\vec{p} + \vec{q}$ and $(\vec{p} - \vec{q})$, $|\vec{r}| = \sqrt{3}$, $\vec{r} = a\hat{i} + b\hat{j} + c\hat{k}$. Find $|a| + |b| + |c|$.

60. A spherical balloon of radius 16 m subtends 60° at eye of an observer on the ground. The angle of elevation of centre from the same point of observation is 75° . Find the height of top most point of the balloon.

61. $f(x) = \begin{cases} \mu, & x = 2 \\ e^{\frac{\tan(x-2)}{x-[x]}}, & x < 2, f(x) \text{ is continuous. Find } \mu + \lambda = \\ \frac{|x^2-5x+6|\lambda}{(-x^2+5x-6)\mu}, & x > 2 \end{cases}$

62. $x^2 + 5\sqrt{2}x + 10 = 0$, $P_n = \alpha^n - \beta^n$, $\frac{P_{17}P_{20}+5\sqrt{2}}{P_{18}P_{19}+5\sqrt{2}} \frac{P_{17}P_{19}}{P_{18}^2} = ?$

