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Full Syllabus

JEE-Main

Paper-4

Test Date: **M.M:300**

TEST INSTRUCTIONS

1. The test is of **3 hours** duration.
2. The test booklet consists of **75 questions**.
3. The maximum marks are **300**.
4. All questions are compulsory.
5. There are three parts in the questions paper consisting of Physics, Chemistry and Mathematics having **25 questions in each part**.

Each Parts Contains –

- 20 multiple choice questions. Each question has four choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct. All questions are carrying **+4 marks** for right answer and **-1 mark** for wrong answer.
- 05 questions with answer as **numerical value** all questions are carrying **+4 marks** for right answer and **–1 marks** for wrong answers.

Name of the Candidate (in Capital Letter): _____

Registration No. _____

Invigilator Signature

_____

Physics

(Single Correct Choice Type)

This Section contains **20 multiple choice questions.** Each question has four choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

1. A boy is cycling at 20 km/hr in a direction making on angle 30° north of east. Find the velocity of a second boy cycling towards north so that to him first boy appears to be moving towards east.

   (a) 5 km/hr (b) 10 km/hr (c) 20 km/h (d) 15 km/hr

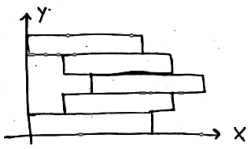
2. The potential energy of a particle of mass 1 kg in a force field is given as $U(x) = \left(\frac{x^4}{4} - \frac{x^2}{2}\right)$J. The total mechanical energy of the particle is 2J then find the maximum speed of particle in its motion.

   (a) $\sqrt{3}$ m/s (b) $\frac{3}{\sqrt{2}}$ m/s (c) $\frac{1}{\sqrt{2}}$ m/s (d) $\frac{3}{2}$ m/s

3. When road of a circular turn is dry the maximum remissible speed for taking a turn on it is 10 m/s. Find the maximum turning speed on wet road when the frictional coefficient between road and tyres reduces to half.

   (a) $5\sqrt{2}$ m/s (b) $\frac{5}{\sqrt{2}}$ m/s (c) 10 m/s (d) $\frac{5}{2}$ m/s

4. Figure shows five uniform brick each of length l. Each brick is placed over another with an offset of length $l/10$. Find the x co-ordinate of center of mass of the system.



   (a) $\frac{29}{40}l$ (b) $\frac{19}{50}l$ (c) $\frac{29}{45}l$ (d) $\frac{29}{50}l$

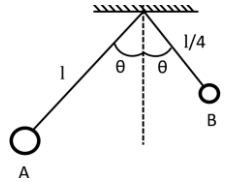
5. A rectangular plate of length 'l' and breadth 'b' of mass m. Find it's moment of inertia about an axis along its diagonal.

   (a) $\frac{1}{6}\frac{ml^2b^2}{(l^2+b^2)}$ (b) $\frac{1}{3}\frac{ml^2b^2}{(l^2+b^2)}$ (c) $\frac{ml^2b^2}{(2l^2+b^2)}$ (d) $\frac{ml^2b^2}{2(l^2+b^2)}$

6. The ratio of thermal conductivities of two materials of different rods of same cross-section is 5 : 3. If the thermal resistance of there rods are in ratio 1 : 3. Find the ratio of length of there rods.

   (a) $\frac{4}{3}$ (b) $\frac{5}{1}$ (c) $\frac{5}{9}$ (d) $\frac{9}{5}$

7. Figure shows two pendulums A and B of length 'l' and '$l/4$' released from rest from the position shown in figure. Calculate the time instant when the two string become parallel for first time.



   (a) $\frac{\pi}{3}\sqrt{\frac{l}{g}}$ (b) $\frac{\pi}{6}\sqrt{\frac{l}{g}}$ (c) $\pi\sqrt{\frac{l}{g}}$ (d) $\frac{2\pi}{3}\sqrt{\frac{l}{g}}$

8. Sound from two identical sources S_1 and S_2 reaches a point (p) where intensity of sound is observed to be I_0. Point p is equidistant from there sources. If intensity of S_1 is increased to 3 times and that of S_2 is decreased by 3 times. Find the sound intensity at point (p).

(a) $\frac{I_0}{6}$ (b) $\frac{16}{9}I_0$ (c) $\frac{16}{3}I_0$ (d) $\frac{16}{11}I_0$

9. An air bubble of radius 1 cm rising at a steady rate of 0.5 cm/s through a liquid of density 0.8 gm/cm^3. Calculate the coefficient of viscosity of the liquid. {Neglect the mass of air}

(a) 32 poise (b) 38.5 poise (c) 35.6 poise (d) None of these

10. A body floats in water with 40% of it's volume outside water. When the same body floats in oil, 60% of its volume remain outside oil. Find the specific gravity of oil.

(a) 2 (b) 3.5 (c) 1.8 (d) 1.5

11. Due to some reasons if earth radius decrease by 6% with it's mass remaining unchanged, what will happen to the acceleration due to a gravity on surface of earth.

(a) will decrease by 9.6% (b) will increase by 8%

(c) will increase by 11.6% (d) will decrease by 12.5%

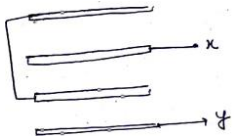
12. Find the angle with dipole at which electric field due to dipole is normal to dipole moment.

(a) $\theta = \tan^{-1}(\sqrt{3})$ (b) $\theta = \tan^{-1}(2)$ (c) $\theta = \tan^{-1}(3)$ (d) $\theta = \tan^{-1}(\sqrt{2})$

13. Two electric charges 'q' and '–2q' are placed at (0, 0) and (6, 0) points, find the locus of zero pointential points in the co-ordinate system.

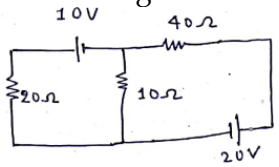
(a) parabola (b) ellipse (c) circle (d) line

14. Figure shows four parallel plates with some connections. If area of plates is 'A' and separation between adjoining plates is 'd'. Find the equivalent capacitance across terminals 'x' and 'y'.



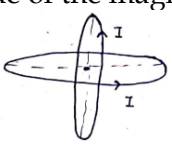
(a) $\frac{2\varepsilon_0 A}{d}$ (b) $\frac{2\varepsilon_0 A}{3d}$ (c) $\frac{\varepsilon_0 A}{2d}$ (d) $\frac{\varepsilon_0 A}{3d}$

15. In the circuit shown in figure, find current flowing in 10Ω resistance



(a) 5A (b) 2A (c) 4A (d) 0A

16. Two insulated circular loop 'A' and 'B' of radius 'a' carrying a current 'I' in the anti clock wise direction as shown in figure. The magnitude of the magnetic induction at the center will be.



(a) $\frac{\sqrt{2}\mu_0 I}{a}$ (b) $\frac{\mu_0 I}{\sqrt{2}a}$ (c) $\frac{\mu_0 I}{2a}$ (d) $\frac{2\mu_0 I}{a}$

17. A long conducting wire having a current 'I' flowing through it, is bent into a circular coil of 'N' turns. Then it is bent into a circular coil of 'n' turns. The magnetic field is calculated at the centre of coils in both the cases. The ratio of magnetic field in first case to that of second case is

(a) $N^2 : n^2$ (b) N : n (c) n : N (d) $n^2 : N^2$

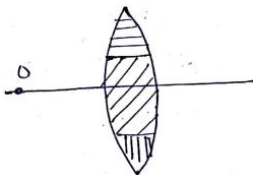
18. A wire of length 1m moving with velocity 8 m/s at right angles to a magnetic field of 2T. The magnitude of induced emf, between the end's of wire will be

(a) 8V (b) 20V (c) 16V (d) 12V

19. A proton, an electron and an alpha particle have the same energies, their de-broglie wavelength will be compared as

(a) $\lambda_p > \lambda_e > \lambda_\alpha$ (b) $\lambda_\alpha > \lambda_p > \lambda_e$ (c) $\lambda_e > \lambda_\alpha > \lambda_p$ (d) $\lambda_p < \lambda_e < \lambda_\alpha$

20. A lens is made up of 3 different transparent media as shown in figure. A point object O is placed on its axis beyond 2f. How many real images will be obtained on the other side.



(a) 2 (b) 1

(c) No image will be found (d) 3

(Integer Type Questions)

This Section contains **05 Questions.** The answer to each question is a single digit integer ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

21. ε_0 and μ_0 are the electric permittivity and magnetic permeability of free space respectively. If the corresponding quantities of a medium are $2\varepsilon_0$ and $1.5\ \mu_0$ respectively, the refractive index of medium is $\sqrt{x}$ then value of 'x' is

22. A silver wire has mass (0.6 ± 0.006)g and radius (0.5 ± 0.005)mm and length (4 ± 0.04) cm. The maximum percentage error in the measurement of it's density will be

23. A body is launched up an inclined plane with inclination 'α' to horizontal. It is observe that the coeff of friction is $\frac{3}{5}\tan\alpha$ then ratio of time of decent and acent along length of inclined is

24. A small block slides down an inclined plane with inclination angle 'α' with horizontal. The coefficient of friction depends on the distance 'x' covered as $\mu = kx$, where 'k' is constant distance travelled by block till it stops is $\frac{n\tan\alpha}{k}$ then value of 'n' is

25. Wall of a container can beer a maximum pressure of 10^6 Pa. It encloses a gas at a pressure of 8×10^5 Pa at 300 K temperature. If temperature of container is gradually increased, find the temperature at which container will break. (in kelvin)

Chemistry

(Single Correct Choice Type)

This Section contains **20 multiple choice questions.** Each question has four choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

1. Consider the following reaction:

$$xMnO_4^- + yC_2O_4^{2-} + zH^+ \rightarrow xMn^{2+} + 2yCO_2 + \frac{z}{2}H_2O$$

The value's of x, y and z in the reaction are, respectively:

(a) 5, 2 and 16 (b) 2, 5 and 8 (c) 2, 5 and 16 (d) 5, 2 and 8

2. Experimentally it was found that a metal oxide has formula $M_{0.98}O$. Metal M, present as M^{2+} and M^{3+} in its oxide. Fraction of the metal which exists as M^{3+} would be:

(a) 7.01% (b) 4.08% (c) 6.05% (d) 5.08%

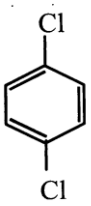
3. The electrons identified by quantum numbers n and l :

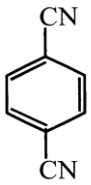
(A) n = 4, l = 1 (B) n = 4, l = 0 (C) n = 3, l = 2 (D) n = 3, l = 1

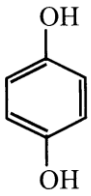
can be placed in order of increasing energy as :

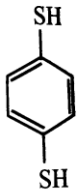
(a) C < D < B < A (b) D < B < C < A (c) B < D < A < C (d) A < C < B < D

4. For which of the following molecule significant $\mu \neq 0$?

(i) 

(ii) 

(iii) 

(iv) 

(a) Only i (b) i and ii (c) Only iii (d) iii and iv

5. A piston filled with 0.04 mol of an ideal gas expands reversibly from 50.0 mL to 375 mL at a constant temperature of 37.0°C. As it does so, it absorbs 208 J of heat. The values of q and w for the process will be: (R = 8.314 J/mol K) (ln 7.5 = 2.01)

(a) q = +208 J, w = –208 J (b) q = –208 J, w = –208 J

(c) q = –208 J, w = +208 J (d) q = +208 J, w = +208 J

6. The following reaction is performed at 298 K.

$$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$$

The standard free energy of formation of NO(g) is 86.6 kj/mol at 298 K. What is the standard free energy of formation of NO_2(g) at 298 K? ($K_p = 1.6 \times 10^{12}$)

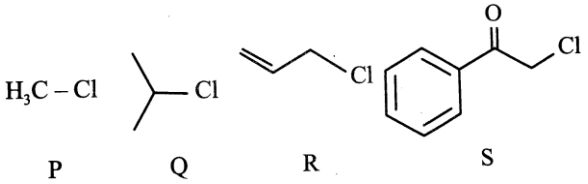
(a) $86600 - \frac{\ln(1.6 \times 10^{12})}{R(298)}$ (b) $0.5[2 \times 86{,}600 - R(298) \ln(1.6 \times 10^{12})]$

(c) $R(298) \ln(1.6 \times 10^{12}) - 86600$ (d) $86600 + R(298) \ln(1.6 \times 10^{12})$

7. The equilibrium constant at 298 K for a reaction A + B $\rightleftharpoons$ C + D is 100. If the initial concentration of all the four species were 1 M each, then equilibrium concentration of D in mol L^{-1} will be:

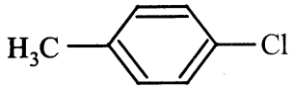
(a) 1.818 (b) 1.182 (c) 0.182 (d) 0.818

8. KI in acetone, undergoes S_N2 reaction with each of P, Q, R and S. The rates of the reaction vary as



(a) P > Q > R > S (b) S > P > R > Q (c) P > R > Q > S (d) R > P > S > Q

9. The IUPAC name(s)of the following compound is(are)



(a) 1-chloro-4-methylbenzene (b) none of these

(c) 4-methylchlorobenzene (d) 1-methyl-4-chlorobenzene

10. Which of the following compounds will exhibit geometrical isomerism?

(a) 2-Phenyl-1-butene (b) 1, 1-Diphenyl-1-propene

(c) 1-Phenyl-2-butene (d) 3-Phenyl-1-butene

11. Liquid 'M' and liquid 'N' form an ideal solution. The vapour pressures of pure liquids 'M' and 'N' are 450 and 700 mmHg, respectively, at the same temperature. Then correct statement is:
(x_M = Mole fraction of 'M' in solution; x_N = Mole fraction of 'N' in solution;
Y_M = Mole fraction of 'M' in vapour phase; y_N = Mole fraction of 'N' in vapour phase)

(a) $\frac{x_M}{x_N} = \frac{y_M}{y_N}$ (b) $(x_M - y_M) < (x_N - y_N)$

(c) $\frac{x_M}{x_N} < \frac{y_M}{y_N}$ (d) $\frac{x_M}{x_N} > \frac{y_M}{y_N}$

12. Resistance of 0.2 M solution of an electrolyte is 50 Ω. The specific conductance of the solution is 1.4 S m^{-1}. The resistance of 0.5 M solution of the same electrolyte is 280 Ω. The molar conductivity of 0.5 M solution of the electrolyte in S m^2 mol^{-1} is:

(a) 5×10^{-4} (b) 5×10^{-3} (c) 5×10^{3} (d) 5×10^{2}

13. The half life period of a first order chemical reaction is 6.93 minutes. The time required for the completion of 99% of the chemical reaction will be (log 2 = 0.301)

(a) 23.03 minutes (b) 46.06 minutes (c) 460.6 minutes (d) 230.03 minutes

14. Among the following oxoacids, the correct decreasing order of acid strength is:

(a) $HOCl > HClO_2 > HClO_3 > HClO_4$ (b) $HClO_4 > HOCl > HClO_2 > HClO_3$

(c) $HClO_4 > HClO_3 > HClO_2 > HOCl$ (d) $HClO_2 > HClO_4 > HClO_3 > HOCl$

15. Which of the following pairs represent linkage isomers?

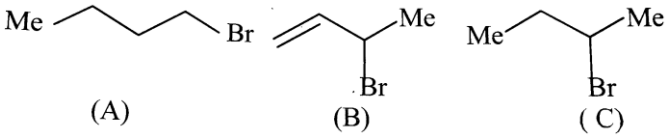
(a) $[Pd(P\ Ph_3)_2(NCS)_2]$ and $[Pd\ (P\ Ph_3)_2\ (SCN)_2]$ (b) $[Co(NH_3)_5NO_3]SO_4$ and $[Co(NH_3)_5SO_4]NO_3$

(c) $[PtCl_2(NH_3)_4]Br_2$ and $[PtBr_2(NH_3)_4]Cl_2$ (d) $[Cu(NH_3)_4]PtCl_4]$ and $[Pt(NH_3)_4][CuCl_4]$

16. Consider the following complex ions, P, Q and R. P = $[FeF_6]^{3-}$, Q = $[V(H_2O)_6]^{2+}$ and R = $[Fe(H_2O)_6]^{2+}$ The correct order of the complex ions, according to their spin-only magnetic moment values (in B.M.) is

(a) R < Q < P (b) Q < R < P (c) R < P < Q (d) Q < P < R

17. Consider the following bromides:



(A) (B) (C)

The correct order of S_N1 reactivity is

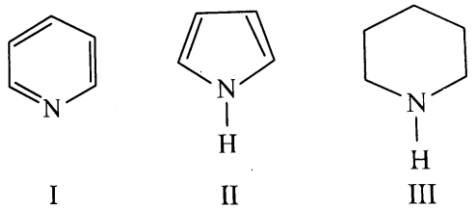
(a) B > C > A (b) B > A > C (c) C > B > A (d) A > B > C

18. In the reaction,

$CH_3COOH \xrightarrow{LiAH_4} A \xrightarrow{PCl_5} B \xrightarrow{Alc.KOH} C$, the product C is:

(a) Acetaldehyde (b) Acetylene (c) Ethylene (d) Acetyl chloride

19. Arrange the following amines in the decreasing order of basicity:



I II III

(a) I > II > III (b) III > I > II (c) III > II > I (d) I > III > II

20. The term anomers of glucose refers to

(a) enantiomers of glucose

(b) isomers of glucose that differ in configuration at carbon one (C-1)

(c) isomers of glucose that differ in configurations at carbons one and four (C-1 and C-4)

(d) a mixture of (D)-glucose and (L)-glucose

(Integer Type Questions)

This Section contains **05 Questions.** The answer to each question is a single digit integer ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

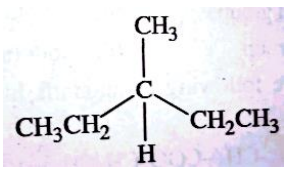
21. Total number of isomers, considering both structural and stereoisomers of cyclic ethers with the molecular formula C_4H_8O is _____

22. In an atom, the total number of electrons having quantum numbers n = 4, $|m_l| = 1$ and $m_s = -\frac{1}{2}$ is

23. Among B_2H_6, $B_3N_3H_6$, N_2O, N_2O_4, $H_2S_2O_3$, $H_2S_2O_8$, the total number of molecules containing covalent bond between two atoms of the same kind is _____

24. In 1 L saturated solution of AgCl [$K_{sp}(AgCl) = 1.6 \times 10^{-10}$], 0.1 mol of CuCl [$K_{sp}(CuCl) = 1.0 \times 10^{-6}$] is added. The resultant concentration of Ag^+ in the solution is 1.6×10^{-x}. The value of "x" is

25. The maximum number of isomers (including stereoisomers) that are possible on monochlorination of the following compound is



Mathematics

(Single Correct Choice Type)

This Section contains **20 multiple choice questions.** Each question has four choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

1. $\int_0^{\frac{\pi}{2}} \sin^{20} x \cdot \cos^{20} x \, dx = \frac{1}{\lambda}\int_0^{\frac{\pi}{2}} \sin^{20} x \, dx$, then λ is equal to

   (a) 2^{20} (b) 2^{10} (c) 2^{-20} (d) 2^{19}

2. If A is 3×3 matrix such that $A^T = 5A + 2I$, where A^T is the transpose of A and I is the 3×3. Identify matrix, then there exist a column matrix $x = \begin{bmatrix} x \\ y \\ z \end{bmatrix} \neq \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$. Then AX is equal to

   (a) AX = X (b) $AX = -\frac{X}{2}$ (c) AX = –2X (d) AX = 0

3. $\lim_{n\to\infty} \sum_{r=1}^{2n} \frac{r}{\sqrt{n^2 + r^2}}$ equals

   (a) $\sqrt{5}$ (b) $\sqrt{2} - 1$ (c) $\sqrt{5} - 1$ (d) $1 + \sqrt{2}$

4. If f(x) is a polynomial function satisfying $f(x) \cdot f\left(\frac{1}{x}\right) + 3f(x) + 3f\left(\frac{1}{x}\right) = 0$ and f(3) = 24, then the value of f(–2) + f(2) is

   (a) 2 (b) –6 (c) 0 (d) None of these

5. The locus of the midpoint of the chord of the ellipse $49x^2 + 16y^2 = 784$. The tangent at ends of which intersect on the circle $x^2 + y^2 = 100$ is

   (a) $(49x^2 + 16y^2)^2 = \left(\frac{784}{10}\right)^2 (x^2 - y^2)$ (b) $49x^2 + 16y^2 = \frac{784}{10}$

   (c) $(49x^2 + 16y^2)^2 = \left(\frac{784}{10}\right)^2 (x^2 + y^2)$ (d) None of these

6. The maximum value of $y = 4\cos 2x + 3\sin x + 5$ is equal to

   (a) 10 (b) $\frac{297}{32}$ (c) 0 (d) None of these

7. The sum $\sum_{r=0}^{30} {}^{30}C_r . \sin(rx).\cos(30 - r)x$ is equal to

   (a) $2^{30}.\cos 30x$ (b) $2^{29}.\cos 30x$ (c) $2^{29}.\sin 29x$ (d) $2^{29}.\sin 30x$

8. If $a, b, c \in R$ are distinct number in A.P a, α, b are in G.P, b, β, c are also in G.P, then α^2, b^2, β^2 will be in

   (a) A.P (b) G.P (c) H.P (d) None of these

9. If the plane passing through the points (a, 1, 1) (1, 2, 1) and (2, 3, 4) is parallel to the line $\vec{r} = \lambda(\hat{i} - \hat{j} + 2\hat{k})(\lambda \in R)$, then a is equal to

(a) $-\frac{1}{2}$ (b) –1 (c) $\frac{3}{2}$ (d) 0

10. The area s ∩ s′ is where $S = \left\{(x, y); \frac{y(3x-1)}{x(3x-2)} < 0\right\}$ and

S′ = {(x, y) ∈ A × B, –1 ≤ A ≤ 1 and –1 ≤ B ≤ 1}

(a) 1 (b) 2 (c) 3 (d) 4

11. Let chord of contact to drawn from Every point lying on circle $x^2 + y^2 = 36$ to the ellipse $\frac{x^2}{4} + \frac{y^2}{9} = 1$ such that all the lines touches an standard ellipse whose electricity is

(a) $\frac{\sqrt{65}}{9}$ (b) $\frac{\sqrt{5}}{3}$ (c) $\frac{4}{5}$ (d) None of these

12. Let tangents PA & PB are drawn from variable point P on the parabola $y^2 = 4x$ to the circle $x^2 + y^2 + 6x - 4y - 3 = 0$ then the director circle of locus of circumcenter of ΔPAB is

(a) x + 2 = 0 (b) $x^2 + y^2 + 6x - 4y - 19 = 0$ (c) $x = -\frac{1}{2}$ (d) None of these

13. The differential equation of the curve $\frac{x}{a-1} + \frac{y}{a+1} = 1$ is given by

(a) (y′ – 1)(y + xy′) = 2y′ (b) (y′ + 1)(y + xy′) = y′

(c) (y′ + 1)(y – xy′) = 2y′ (d) None of these

14. If $f(x) = \begin{cases} b\,\text{sgn}(\cos^{-1}x - \cos^{-1}x^2), & x > 0 \\ \frac{\sin^{-1}x - x}{x^3}, & x < 0 \\ a, & x = 0 \end{cases}$ is continuous at x = 0, then a + b equal to

(a) 0 (b) $\frac{1}{3}$ (c) $-\frac{1}{3}$ (d) None of these

15. From first 100 natural number, 3 numbers are selected if these numbers are in A.P. then find probability that these numbers are even.

(a) $\frac{1}{66}$ (b) $\frac{29}{66}$ (c) $\frac{29}{49}$ (d) $\frac{12}{49}$

16. $\int \frac{3\cos x}{2\cos x + 5\sin x} dx$ is equal to

(a) $\frac{15}{29}x + \frac{6}{29}\ln|2\cos x + 5\sin x| + C$ (b) $\frac{6}{29}x - \frac{15}{29}\ln|2\cos x + 5\sin x| + C$

(c) $\frac{6}{29}x + \frac{15}{29}\ln|2\cos x + 5\sin x| + C$ (d) None of these

[Note: where C is integration constant]

17. Let $S_n = \cot^{-1}\left(6x+\frac{2}{x}\right)+\cot^{-1}\left(10x+\frac{2}{x}\right)+\cot^{-1}\left(15x+\frac{2}{x}\right)+\ldots\ldots\ldots\ldots+n$ term, where $x > 0$

If $\lim\limits_{n\to\infty} S_n = 1$ then x equals

(a) $\cot 1$ (b) $\frac{2}{3}\cot 1$ (c) $\frac{3}{2}\tan 1$ (d) None of these

18. If x, y, z satisfy the system of equation $\tan^2 x + \cot^2 x = 2\cos^2 y$ and $\cos^2 y + \sin^2 z = 1$

then value of $\int\limits_{\cos^2 y}^{\sec^2 x+\sec^2 z} \frac{t^2}{t^2-4t+8}dt$ is equal to

(a) 0 (b) 1 (c) 2 (d) 3

19. If $\arg\left(\frac{z_1-\frac{z}{|z|}}{\frac{z}{|z|}}\right)=\frac{\pi}{2}$ and $\left|\frac{z}{|z|}-z_1\right|=3$, then $|z_1|$ is equal to

(a) $\sqrt{3}$ (b) $\sqrt{26}$ (c) $\sqrt{10}$ (d) $2\sqrt{2}$

20. Let $\vec{r}$ be a position vector of a variable point in x-y plane such that $\vec{r}.(6\hat{j}-4\hat{i}+\vec{r})=3$, then the maximum value of $|\vec{r}+2\hat{i}-3\hat{j}|$ is equal to

(a) $2+\sqrt{13}$ (b) $2(2+\sqrt{13})$ (c) $2+2\sqrt{13}$ (d) $4+\sqrt{13}$

(Integer Type Questions)

This Section contains **05 Questions.** The answer to each question is a single digit integer ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

21. If $(1+x+x^2+x^3)^{100}=\sum\limits_{r=0}^{300} a_r.x^r$ and $\sum\limits_{r=0}^{300} a_r = k$, then the value of $\sum\limits_{r=0}^{300} r.a_r = \lambda k$. Find value of λ.

22. If $f(x) = \sin x$ and $g(x) = \underbrace{f(f(f...f(x)))}_{2018\ times}$, then the value of $g'(0) + g''(0) + g'''(0)$ is equal to

23. A 10 digit number start with 2 and all its digits are prime, then the probability that the sum of are two consecutive digits of the number if prime is $\frac{1}{2^k}$. Find value of k

24. Let $f(x)=\begin{cases}\left(\sin\frac{2x^2}{a}+\cos\frac{3x}{b}\right)^{\frac{ab}{x^2}}, & x\neq 0\\ e^{2x+3}, & x=0\end{cases}$

is continuous function at $x = 0$, $\forall\ b \in R$ then $\left|\frac{1}{a_{min}}\right|$ is equal to

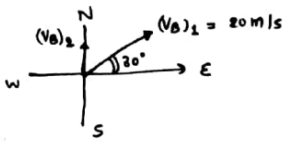
25. Let α and β are the roots of the equation $x^2 - 6x + 12 = 0$. If the value of $(\alpha-2)^{12} + \frac{(\beta-6)^{12}}{\alpha^{12}} - 1$ is a^b, then minimum value of $(a + b)$ is equal to

Answer – key

Physics		11.	C	21.	3	6.	b	16.	b	**Math**		11.	a	21.	150				
1.	B	12.	D	22.	4	7.	a	17.	a	1.	a	12.	a	22.	-2017				
2.	B	13.	C	23.	2	8.	b	18.	c	2.	b	13.	c	23.	13				
3.	A	14.	–	24.	2	9.	a	19.	b	3.	c	14.	a	24.	4				
4.	D	15.	D	25.	375	10.	c	20.	b	4.	b	15.	d	25.	10				
5.	A	16.	B	**Chemistry**		11.	d	21.	10	5.	c	16.	c						
6.	C	17.	A	1.	c	12.	a	22.	6	6.	b	17.	b						
7.	A	18.	C	2.	b	13.	b	23.	4	7.	d	18.	c						
8.	C	19.	B	3.	b	14.	c	24.	7	8.	a	19.	c						
9.	C	20.	D	4.	d	15.	a	25.	8	9.	d	20.	b						
10.	D			5.	a					10.	b								

Solution

Physics

① 

Velocity of Boy(1) w.r.t Boy(2) should be towards east.

for that

$(V_B)_2 = (V_B)_1 \sin 30°$

↓

Component to $(V_B)_1$ towards North.

$(V_B)_2 = 20\sin 30° = 10$

$\boxed{(V_B)_2 = 10\,m/s}$

② $U(x) = \left(\frac{x^4}{4} - \frac{x^2}{2}\right)J$

PE will be minimum when KE will be maximum.

$\frac{dU(x)}{dx} = 0 \Rightarrow x^3 - x = 0$

$x(x^2 - 1) = 0$

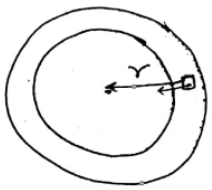
$x = 0,\ x = 1,\ x = -1$

$\frac{d^2U}{dx} > 0$ for $x = \pm 1$

$U(x)_{min} = \left(\frac{(1)^4}{4} - \frac{(1)^2}{2}\right) = \frac{1}{4} - \frac{1}{2} = -\frac{1}{4}$

$ME = \underset{\text{min}}{PE} + \underset{\text{max}}{KE} \Rightarrow (KE)_{max} = \frac{9}{4}$

$2 = \left(-\frac{1}{4}\right) + (KE)_{max}$ $\qquad \frac{1}{2}(1)V_{max}^2 = \frac{9}{4} \Rightarrow \boxed{V_{max} = \frac{3}{\sqrt{2}}}$

③ 

Case-1

$N = mg$

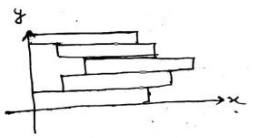
$f_{max} = \mu mg = \frac{mv^2}{r}$

$v^2 = \mu rg$

$(v)_{max} = \sqrt{\mu rg} = 10\,m/s$

When coefficient of friction is $(1/2)$

$(v)_{max} = \sqrt{\left(\frac{1}{2}\right)rg} = \frac{10}{\sqrt{2}} = (5\sqrt{2})\,m/s$

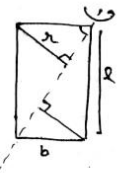
④ 

let mass of each Rod is (M)

$COM = \frac{m_1x_1 + m_2x_2 + \cdots}{m_1 + m_2 + \cdots}$

$COM = \frac{2m(1/2) + 2m\left(\frac{1}{2} + \frac{1}{10}\right) + m\left(\frac{1}{2} + \frac{2}{10}\right)}{5m} = \left(\frac{29}{50}\right)$

⑤ MI of rectangular plate can be given as



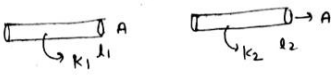
$I = 2$ (MI of the triangular plates as shown)

$I = 2\left(\frac{1}{6}\left(\frac{M}{2}\right)r^2\right)$

$\boxed{I = \frac{1}{6}\frac{Ml^2b^2}{(l^2+b^2)}}$

$\frac{r}{b} = \frac{l}{\sqrt{l^2+b^2}}$

$r = \frac{lb}{\sqrt{l^2+b^2}}$

⑥ 

given

$K_1 : K_2 = 5:3$

$R_1 : R_2 = 1:3$

$R_1 = \frac{l_1}{K_1A}$, $R_2 = \frac{l_2}{K_2A}$

$\frac{R_1}{R_2} = \left(\frac{l_1}{K_1A}\right)\left(\frac{K_2A}{l_2}\right) = \left(\frac{K_2}{K_1}\right)\left(\frac{l_1}{l_2}\right)$

$\frac{1}{3} = \left(\frac{3}{5}\right)\left(\frac{l_1}{l_2}\right) \Rightarrow \boxed{\frac{l_1}{l_2} = \frac{5}{9}}$

⑦ $T_A = 2\pi\sqrt{l/g}$ $\qquad T_B = 2\pi\sqrt{\frac{l}{4g}}$

$\frac{2\pi}{\omega_A} = 2\pi\sqrt{l/g}$ $\qquad \frac{2\pi}{\omega_B} = \pi\sqrt{\frac{l}{g}}$

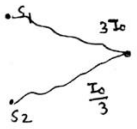
$\omega_A = \sqrt{g/l}$ $\qquad \omega_B = 2\sqrt{g/l}$

$\omega_{AB} = \sqrt{g/l} + 2\sqrt{g/l} = 3\sqrt{g/l}$ {bcz both are in posite dirn}.

both ~~the~~ string will be parallel when any of body will cover (π) displacement w.r.t to another

$\pi = (\omega_{AB})t$

$\pi = 3\sqrt{g/l}\,t \Rightarrow \boxed{t = \frac{\pi}{3}\sqrt{l/g}}$

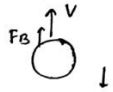
⑧ 

$(\sqrt{3I_0} + \sqrt{\frac{I_0}{3}})^2 = I_0\left(\sqrt{3} + \frac{1}{\sqrt{3}}\right)^2$

$= I_0\left(\frac{4}{\sqrt{3}}\right)^2$

$\boxed{I_{net} = \frac{16}{3}I_0}$

⑨ F_B (Buoyant force) = FV (Viscous force)



$\left(\frac{4}{3}\pi r^3\rho_L\right)g = 6\pi\eta rV$

$\eta = \frac{2}{9}\frac{r^2\rho_L g}{V} = 35.55\,poise$

(10) Let volume of body is (V)

for floatation $mg = 0.6 V \rho_w g$ —(i) {in case of water}

In case of oil

$mg = 0.6 V \rho_0 g$ —(ii)

from eqn (i) & (ii)

$\frac{\rho_0}{\rho_w} = \frac{3}{2} = 1.5$ ← specific gravity

(11) $g_s = \frac{GM_e}{R_e^2}$ $\quad R_e \longrightarrow 0.94 R_e$

$g_{new} = \frac{GM_e}{(0.94 R_e)^2} = \frac{GM_e}{0.884 R_e^2}$

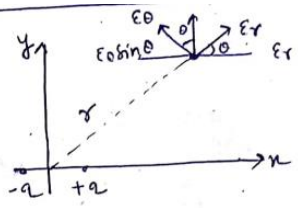
$g_{net} = \frac{GM_e}{(1-0.116) R_e^2} = \frac{GM_e}{R_e^2}(1-0.116)^{-1}$

$(1+x)^n \approx 1+nx$

$g_{new} = g_s(1+0.116) = 1.116\, g_s$

→ value of 'g' increased by 11.6%.

(12)



for net electric field to be in y dirn

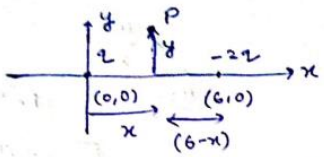
we should be have

$E_r \cos\theta = E_\theta \sin\theta$

$\left(\frac{2KP\cos\theta}{r^3}\right)\cos\theta = \left(\frac{KP\sin\theta}{r^3}\right)\sin\theta$

$\theta = \tan^{-1}(\sqrt{2})$

(13)



Let potential at point (P) is zero.

So, $\frac{Kq}{(\sqrt{x^2+y^2})} + \frac{K(-2q)}{\sqrt{y^2+(6-x)^2}} = 0$

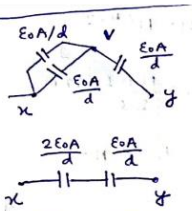
$\frac{1}{(x^2+y^2)} = \frac{4}{y^2+(6-x)^2}$

$y^2 + (6-x)^2 = 4x^2 + 4y^2$

$y^2 + 36 + x^2 - 12x = 4x^2 + 4y^2$

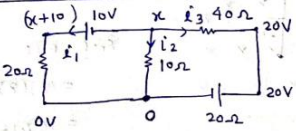
$3x^2 + 3y^2 + 12x - 36 = 0$ → circle

(14)



$C_{eq} = \frac{2\varepsilon_0 A}{3d}$

(15)



$i_1 + i_2 + i_3 = 0$

$\left(\frac{x+10}{20}\right) + \left(\frac{x-0}{10}\right) + \left(\frac{x-20}{40}\right) = 0$

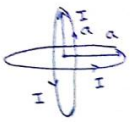
$2x + 20 + 4x + x - 20 = 0$

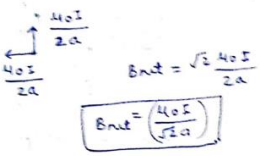
$7x = 0$

$x = 0$

current (i) from 10Ω = 0 → due to NO potential diffn

(16)





(17)

Case-I

Let length of wire is (l)

$l = N(2\pi r_1)$

$r_1 = \left(\frac{l}{2\pi N}\right)$

$B_1 = N\left\{\frac{40I}{2r}\right\}$

$B_1 = \frac{N 40 I (2\pi N)}{2l}$

$B_1 \propto N^2$

Case-II

$l = n(2\pi r_2)$

$r_2 = \left(\frac{l}{2\pi n}\right)$

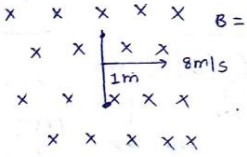
$B_2 = n\left\{\frac{40I}{2r_2}\right\}$

$B_2 = \frac{n\,40I\,(2\pi n)}{2(l)}$

$B_2 \propto n^2$

$B_1 : B_2 = N^2 : n^2$

(18)



$Emf = BV\ell$

$= (2)(8)(1)$

$= 16 Volt$

(19)

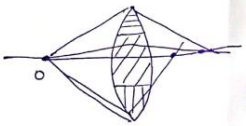
$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2KEm}}$ if KE is same

$\lambda \propto \frac{1}{\sqrt{m}}$

$m_\alpha > m_p > m_e$

$\lambda_\alpha < \lambda_p < \lambda_e$

(20)



due to different Refractive index, image will be ~~for~~ formed at 3 different Place.

(21)

$C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ $\quad V = \frac{1}{\sqrt{\mu_0 \varepsilon_0 \mu_r \varepsilon_r}}$

$V = \frac{c}{\sqrt{\mu_r \varepsilon_r}} = \frac{c}{\sqrt{2(1.5)}} = \frac{c}{\sqrt{3}}$

Refractive index $= \sqrt{3}$

$x = 3$

(22)

$m = (0.6 + 0.006)\,g$

$r = (0.5 \pm 0.005)\,mm$

$\ell = (4 + 0.04)\,cm$

$\rho = \frac{m}{V}$

$\rho = \frac{m}{\pi r^2 \ell}$

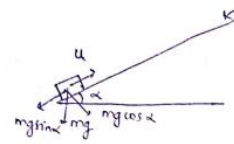
$\frac{\Delta\rho}{\rho} = \frac{\Delta m}{m} + 2\frac{\Delta r}{r} + \frac{\Delta \ell}{\ell}$

$\frac{\Delta\rho}{\rho} \times 100 = \frac{\Delta m}{m} \times 100 + 2\frac{\Delta r}{r} \times 100 +$

$\frac{\Delta\rho}{\rho} \times 100 = \left(\frac{0.006}{0.6} \times 100\right) + 2\left(\frac{0.005}{0.5}\right) \times 100 + \left(\frac{0.04}{4} \times 100\right) \frac{\Delta \ell}{\ell} \times 100$

$= 1 + 2 + 1 = 4\%$.

(23)



$u = \frac{3}{5} t\tan\alpha$

$F_{net} = mg\sin\alpha + \mu mg\cos\alpha$

$F_{net} = mg\sin\alpha + \left\{\frac{3}{5} \tan\alpha\, mg\cos\alpha\right\}$

$F_{net} = \frac{8}{5} mg\sin\alpha$

$a = \frac{8}{5} g\sin\alpha$

$v^2 = u^2 + 2as$

$0 = u^2 - 2\left\{\frac{8}{5} g\sin\alpha\right\} s$

$s\left(\frac{16}{5} g\sin\alpha\right) = u^2 \Rightarrow s = \frac{5u^2}{16 g\sin\alpha}$

$\Rightarrow v = u + at$

$0 = u + \left\{-\frac{8}{5} g\sin\alpha\right\} t$

$\left(\frac{8}{5} g\sin\alpha\right) t = u$

$t = \frac{5u}{(8 g\sin\alpha)}$

• for time of decent

$F_{net} = mg\sin\alpha - 2\mu mg\cos\alpha$

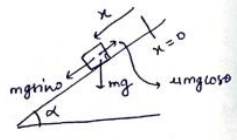
$\left(a = \frac{2}{5} g\sin\alpha\right)$

$s = ut + \frac{1}{2} at^2 \Rightarrow \frac{5u^2}{16 g\sin\alpha} = \frac{1}{2} \left\{\frac{2}{5} g\sin\alpha\right\} t^2$

$\frac{25u^2}{16 g^2 \sin^2\alpha} = t^2 \Rightarrow t = \frac{5u}{4g\sin\alpha}$

$\frac{t_a}{t_d} = \frac{1}{2} \Rightarrow \frac{t_d}{t_a} = 2$

(24)



F_{net} at general distance (x)

$mg\sin\theta - kxg\,m\cos\theta$.

$a_{net} = g\sin\theta - kxg\cos\theta$

$0 = \left(g\sin\theta x - kg\cos\theta \frac{x^2}{2}\right)$

$x = \frac{2\tan\theta}{k} \Rightarrow n = 2$

$\frac{v\,dv}{dx} = g\sin\theta - kg\cos\theta x$

$\int_0^0 v\,dv = \int_0^x g\sin\theta\, dx - \int_0^x kg\cos\theta\, x\, dx$

(25)

300K

$P_i = 8 \times 10^5$ Pa

Volume is cont

Pressure at which container break $= 10^6$ Pa

$\frac{P_i}{T_i} = \frac{P_f}{T_f} \Rightarrow \frac{8 \times 10^5}{300} = \frac{10^6}{T_f} \Rightarrow$

$T_f = \frac{300 \times 10}{8} = 375$

$T_f = 375\,k$

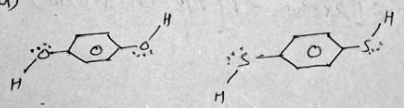
Chemistry

Q.1
Ans → (C) 2, 5 and 16

Q.2. (b)
Ans → For 1 mole of oxide
Moles of M = 0.98, moles of O^{2-} = 1
Lets mole of M^{3+} = x
∴ moles of M^{2+} = 0.98 − x
on balancing charge.
$(0.98-x) * 2 * 3x - 2 = 0$
$x = 0.04$
% of M^{3+} = $\frac{0.04}{.98} \times 100 = 4.08$

Q.3 (b)
Ans → According to bohr Burgy's (n+ℓ)
(D) < (B) < (C) < (A)

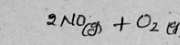
Q.4. (d)
Ans →



In both the molecule the dipole moment not cancelling each other due to V-shape or bent structure. Then ($\mu \neq 0$)

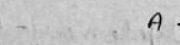
Q.5. (a)
Ans: In isothermal expansion
$\Delta U = 0$
$Q = -W$
$\therefore W = -2.303\ nRT \log \frac{v_2}{v_1}$
$= -2.303 \times 0.04 \times 8.314 \times 310 \times \log \frac{335}{50}$
$\boxed{W = -208\ J}$ & $\boxed{Q = 208\ J}$

Q.6: (b)
Ans.



As $\Delta G^\circ = -RT \ln K_p$
$\therefore 2\Delta G^\circ_{NO_2} - 2\Delta G^\circ_{NO} = -R(298) \ln (1.6 \times 10^{12})$
$2\Delta G^\circ_{NO_2} - 2 \times 86600 = -R(298) \ln (1.6 \times 10^{12})$
$2\Delta G^\circ = 2 \times 86600 - R(298) \ln (1.6 \times 10^{12})$
$\Delta G^\circ = \frac{1}{2}[2 \times 86600 - R(298) \ln (1.6 \times 10^{12})]$
$= 0.5[2 \times 86600 - R(298) \ln (1.6 \times 10^{12})]$

Q.7 (a)
Ans.

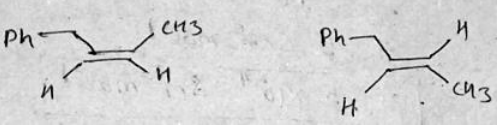


No. of initial mole 1 1 1 1
At equilibrium (1−a) (1−a) (1+a) (1+a)
$\therefore K_c = \frac{(1+a)^2}{(1-a)^2} = 100$
on solving $a = 0.81$
$\therefore$ [D] at equilibrium $(1+a) = 1 + 0.81 = \boxed{1.81}$

Q.8 (b) S > P > R > Q.
Ans:

Q.9 (a) & (b)
Ans

Q.10 : (C)
Ans : 1-phenyl-2-butene



Q.11. (d)
Ans. $P_M^\circ = 450$ mm Hg, $P_N^\circ = 700$ mm Hg
$P_M = P_M^\circ x_M = y_M P_T$
$P_M^\circ = \frac{y_M}{x_M}(P_T)$
Similarly $P_M^\circ = \frac{y_M}{x_N}(P_T)$
Given $P_M^\circ < P_N^\circ$
$\Rightarrow \frac{y_M}{x_M} < \frac{y_N}{x_N}$ | $\frac{y_M}{y_N} < \frac{x_M}{x_N}$

Q.12: (a)
Ans: $R = \rho \frac{l}{a} = \frac{1}{k} \times \frac{l}{a}$
$\frac{1}{a} = R \times k = 50 \times 1.4 \times 10^{-2}$
for 0.5 M solution
$R = 280\ \Omega$; $k = ?$
$\frac{l}{a} = 50 \times 1.4 \times 10^{-2} \Rightarrow R = \rho \frac{l}{a} = \frac{1}{k} \times \frac{l}{a}$
$k = \frac{1}{280} \times 50 \times 1.4 \times 10^{-2}$
$= \frac{1}{280} \times 70 \times 10^{-2} = 2.5 \times 10^{-3}\ Scm^{-1}$
Now $\Lambda_m = \frac{k \times 1000}{M} \Rightarrow \frac{2.5 \times 10^{-3} \times 1000}{0.5}$
$= 5\ Scm^2\ mol^{-1}$
$\boxed{= 5 \times 10^{-4}\ Sm^2\ mol^{-1}}$

Q.13: (b)
Ans: $K = \frac{2.303}{t} \log \frac{100}{100-99}$
$\frac{0.693}{6.93} = \frac{2.303}{t} \log \frac{100}{1}$
by solving $\boxed{t = 46.06\ min}$

Q.14 : (C)
Ans : Acidic strength & (+)ve oxidation No

Q.15 (a)

Ans: Linkage isomerism shown by complexes having ambidentate ligands.

Q.16 (b)

Ans Magnetic moment $\propto$ No of unpaired electron as $\mu = \sqrt{n(n+2)}$ B.M.

In P $\Rightarrow$ $Fe^{3+} \Rightarrow 3d^5 \Rightarrow$ 5 unpaired $\bar{e}$

In Q $\Rightarrow$ $V^{+2} \Rightarrow 3d^3 \Rightarrow$ 3 unpaired $\bar{e}$

In R $\Rightarrow$ $Fe^{2+} \Rightarrow 3d^6 \Rightarrow$ 4 unpaired $\bar{e}$

Q.17 (a)

Ans More will be stability of carbocation higher will be the ~~stability~~ reactivity of alkyl halide towards SN1 Reaction.

ie $3° > 2° > 1°$

Q.18 (c)

Ans: $CH_3COOH \xrightarrow{LiAlH_4} CH_3CH_2OH \xrightarrow{PCl_5} CH_3-CH_2-Cl \xrightarrow{Alc.\ KOH} CH_2=CH_2$ ethylene

Q.19 (b)

Ans III > I > II $\Rightarrow$ III - lone pair free

I - Nitrogen is sp^2 hybridized.

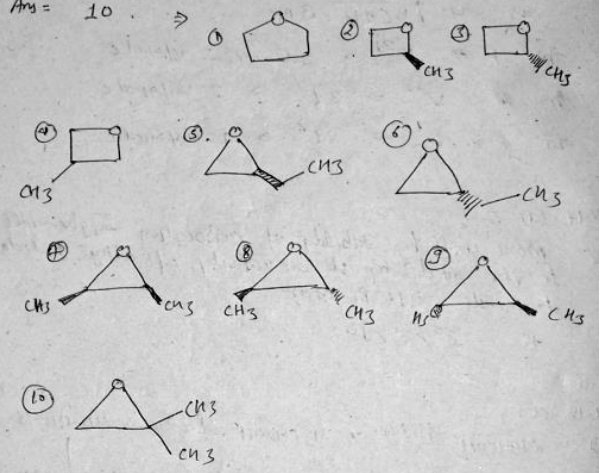
II - lone pair in Resonance.

Q.20 (b)

Ans: It is due to different configuration at C_1 carbon

Q.21

Ans = 10. $\Rightarrow$



Q.22) 9

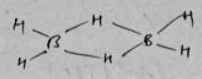
Ans. Maximum No. of electron $2n^2 = 2\times3^2 = 18$

$\therefore$ No. of electron with $m_s = -\frac{1}{2}$ will be 9

Q.23 $\Rightarrow$ 4

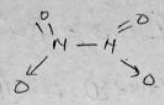
Ans.

B_2H_6

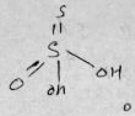


NO_2 $\quad \bar{N}=\overset{+}{N}=O \longleftrightarrow N\equiv\overset{+}{N}-\bar{O} \longleftrightarrow \overset{2-}{N}\equiv\overset{+}{N}\equiv\overset{+}{O}$

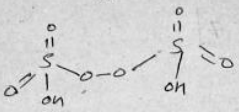
N_2O_4



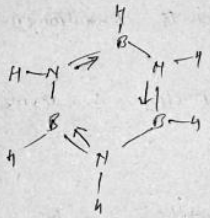
$H_2S_2O_3$



$H_2S_2O_8$



$B_3N_3H_6$



Q.24 $\Rightarrow$ 7

Ans Let the solubility of AgCl is 'x' mol liter^{-1} and that of CuCl is y mole liter^{-1}

$AgCl \rightleftharpoons Ag^+ + Cl^-$

x x

$CuCl \rightleftharpoons Cu^+ + Cl^-$

y y

Ksp of AgCl = $[Ag^+][Cl^-]$

$1.6\times10^{-10} = x(x+y)$ ——— (I)

Similarly, Ksp of CuCl = $[Cu^+][Cl^-]$

$1.6\times10^{-6} = y(x+y)$ ——— (II)

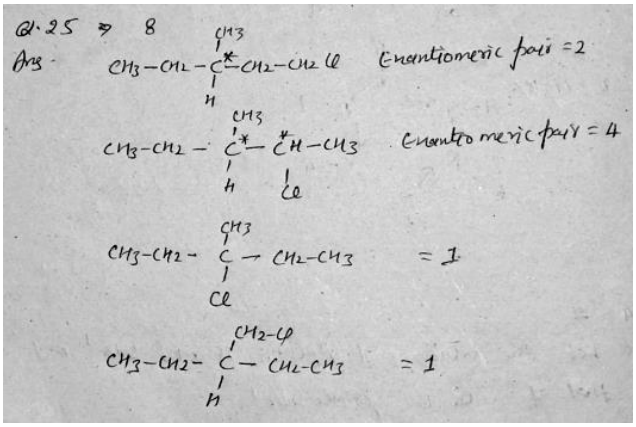
On solving eq. (I) & (II)

$[Ag^+] = 1.6\times10^{-7}$

$\therefore \boxed{x = 7}$

Q.25 $\Rightarrow$ 8

Ans



Math

1. [A]

$$\frac{1}{2^{20}}\int_0^{\pi/2}(2\sin x\cos x)^{20}\,dx = \frac{1}{2^{20}}\int_0^{\pi/2}(\sin 2x)^{20}\,dx = \frac{1}{2^{20}}\int_0^{\pi}\sin^{20}t\,\frac{dt}{2}$$

$2x=t$, $2\,dx=dt$, $dx=\frac{dt}{2}$

$$= \frac{1}{2^{20}}\int_0^{\pi/2}\sin^{20}2x\,dx$$

By Applying Queen formula

ie $\int_0^{2a} f(x) = 2\int_0^{a} f(x)$ if $f(2a-x)=f(x)$

2. [B]

$$A^T = 5A+2I$$

Taking Transpose

$$(A^T)^T = (5A)^T + (2I)^T$$

$$A = 5A^T + 2I$$

$$A = 5(5A+2I)+2I$$

$$2A+I=0,\quad 2AX+X=0$$

$$AX = -\frac{X}{2}$$

3. [C]

Change: $\frac{1}{n}\to dx$, $\frac{r}{n}\to x$ (Revise Sum of ∞-Series into Definite Integral)

$$\int_0^2 \frac{x}{\sqrt{1+x^2}}\,dx$$

Assume $1+x^2=t$

4. [B]

$$f(x) = -3+x^3$$

$$f(2)+f(-2) = -6$$

5. [C]

Let Midpoint of chord be (h,k)

$T=S_1$

$$49xh+16yk = 49h^2+16k^2$$

Parametric Point on circle $x^2+y^2=100$ $(10\cos\theta, 10\sin\theta)$

Compare & Eliminate $\sin\theta$ & $\cos\theta$

above Chord is Chord of Contact for circle

$T=0$

$$49x\,10\cos\theta + 16y\,10\sin\theta = 784$$

6. [B]

$$f(x) = 4\cos 2x + 3\sin x + 5$$

$$= 4(1-2\sin^2 x)+3\sin x+5 \qquad \sin x = t \in [-1,1]$$

$$= -8t^2+3t+9$$

find Range of $f(t) = -8t^2+3t+9$, $t\in[-1,1]$

Ref: Restricted domain range in quadratic

7. [D]

$$S = \sum_{s=0}^{30} {}^{30}C_s \sin(3x)\cos(30-s)x \quad -(1)$$

Change $s \to$ Lower Limit + Upper Limit $- s$ (Summation Value does not change)

$s \to 0+30-s$

$$S = \sum_{s=0}^{30} {}^{30}C_{30-s}\sin(30-s)x\cos(30-(30-s))x$$

$$S = \sum_{s=0}^{30} {}^{30}C_s \sin(30-s)x\cos sx \quad -(2)$$

Add Eq^n (1) & (2)

$$2S = \sum_{s=0}^{30} {}^{30}C_s\left(\sin(3x)\cos(30-s)x + \sin(30-s)x\cos(3x)\right)$$

$$= \sum_{s=0}^{30} {}^{30}C_s \sin(3x+30x-3x)$$

$$= \sum_{s=0}^{30} {}^{30}C_s \sin(30x)$$

$$2S = \sin(30x)\sum_{s=0}^{30} {}^{30}C_s$$

$$2S = \sin(30x)\left[{}^{30}C_0+{}^{30}C_1+\cdots+{}^{30}C_{30}\right]$$

$$2S = 2^{30}\sin(30x)$$

$$S = 2^{29}\sin(30x)$$

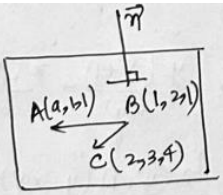
8. [A]

$2b = a+c$, $\beta^2 = bc$, $\alpha^2 = ab$

$$2b = \frac{\alpha^2}{b}+\frac{\beta^2}{b} \Rightarrow \alpha^2+\beta^2 = 2b^2$$

α^2, b^2, β^2 are in A.P

9. [D]



$$\vec{n} = \vec{BA}\times\vec{BC} = \begin{vmatrix} i & j & k \\ a-1 & -1 & 0 \\ 1 & 1 & 3 \end{vmatrix}$$

$\vec{n}$ is $\perp^r$ to Line ie $\hat{i}-\hat{j}+2\hat{k}$

Make dot Product $=0$

10. [B]

11. [A] Parametric Pt of circle $x^2+y^2=36$ $(6\cos\theta, 6\sin\theta)$

Equation of chord of contact $T=0$

$$\frac{x\,6\cos\theta}{4}+\frac{y\,6\sin\theta}{9}=1$$

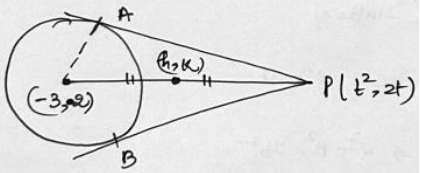
$$\frac{x\cos\theta}{4/6}+\frac{y\sin\theta}{9/6}=1$$

$$e^2 = 1-\left(\frac{4/6}{9/6}\right)^2 = 1-\frac{16}{81} = \frac{65}{81}$$

12. [A] $t^3 - 3 = 2h$ and $2t+2 = 2k$

$(k-1)^2 = 2h+3$, $t = k-1$

$(h,k) \to (x,y)$ $\quad (y-1)^2 = 2\left(x+\frac{3}{2}\right)$



$x + \frac{3}{2} = -\frac{2}{4} \Rightarrow x+2=0$

13. [C]

$\frac{1}{a-1} + \frac{\frac{dy}{dx}}{a+1} = 1 \quad \rightarrow \quad \frac{y(y'+1)}{2y'} + \frac{x(y'+1)}{-2} = 1$

$\Rightarrow a = \frac{\frac{dy}{dx}-1}{\frac{dy}{dx}+1}$ $\quad \hookrightarrow (y'+1)(y-xy') = 2y'$

where $y' = \frac{dy}{dx}$

$a+1 = \frac{2\frac{dy}{dx}}{\frac{dy}{dx}+1}$ & $a-1 = -\frac{2}{\frac{dy}{dx}+1}$

$$= \sum_{x=0}^{n} \tan^{-1}\left(\frac{(x+4)\frac{x}{2} - (x+3)\frac{x}{2}}{1+(x+4)\frac{x}{2}\cdot(x+3)\frac{x}{2}}\right)$$

$S_n = \sum \tan^{-1}(x+4)\frac{x}{2} - \tan^{-1}(x+3)\frac{x}{2}$

$S_n = \tan^{-1}(n+4)\frac{x}{2} - \tan^{-1}\frac{3x}{2}$

$S_\infty = \frac{\pi}{2} - \tan^{-1}\frac{3x}{2} = 1$

$\hookrightarrow \cot^{-1}\frac{3x}{2} = 1$

$\hookrightarrow \frac{3x}{2} = \cot 1$

$x = \frac{2}{3}\cot 1$

14. [A]

15. [D] $\frac{{}^{25}C_2 + {}^{25}C_2}{{}^{50}C_2 + {}^{50}C_2} = \frac{12}{49}$

16. [C] $N^\sigma = A.D^\sigma + B(D^\sigma)'$

$3\cos x = A(2\cos x + 5\sin x) + B(-2\sin x + 5\cos x)$

$3\cos x = \cos x(2A+5B) + \sin x(5A-2B)$

$2A+5B=3$ $\quad 5A-2B=0$

$2\times\frac{2}{5}B + 5B = 3$ $\quad 5A = 2B$

$\frac{29B}{5} = 3$ $\quad A = \frac{2}{5}B$

$B = \frac{15}{29}$ $\quad = \frac{2\times 15}{5\times 29} = \frac{6}{29}$

$$\int \frac{3\cos x}{2\cos x + 5\sin x}\,dx = \int \frac{\frac{6}{29}(2\cos x + 5\sin x) + \frac{15}{29}(-2\sin x + 5\cos x)}{2\cos x + 5\sin x}\,dx$$

$$= \int \frac{6}{29}\,dx + \int \frac{15}{29}\cdot\frac{-2\sin x + 5\cos x}{2\cos x + 5\sin x}\,dx \qquad \left(f(x) = 2\cos x + 5\sin x,\ f'(x) = -2\sin x + 5\cos x\right)$$

$$= \frac{6}{29}x + \frac{15}{29}\ln|2\cos x + 5\sin x| + C$$

17. [B] $S_n = \cot^{-1}\left(\frac{(x+3)(x+4)x}{2} + \frac{x}{2}\right)$

$= \cot^{-1}\left(\frac{(x+3)(x+4)x^2+2}{2x}\right)$

$= \tan^{-1}\left(\frac{x}{1+(x+3)(x+4)x^2+1}\right)$

$= \tan^{-1}\left(\frac{x}{(x+3)(x+4)x^2+2}\right)$

$= \tan^{-1}\left(\frac{\frac{x}{2}}{1+(x+3)\frac{x}{2}\cdot(x+4)\frac{x}{2}}\right)$

$S = \underbrace{6}_{4} + \underbrace{10}_{5} + 15 + \dots + n\text{ terms}$

$t_n = 6 + \frac{4n}{1} + \frac{1}{2}\frac{n(n+1)}{1\cdot 2}$

$= 6 + 4n + \frac{n^2-n}{2}$

$= \frac{12+8n+n^2-n}{2}$

$= \frac{n^2+7n+12}{2}$

$= \frac{(n+3)(n+4)}{2}$

$$= \sum_{x=0}^{n} \tan^{-1}\left(\frac{(x+4)\frac{x}{2} - (x+3)\frac{x}{2}}{1+(x+4)\frac{x}{2}\cdot(x+3)\frac{x}{2}}\right)$$

$S_n = \sum \tan^{-1}(x+4)\frac{x}{2} - \tan^{-1}(x+3)\frac{x}{2}$

$S_n = \tan^{-1}(n+4)\frac{x}{2} - \tan^{-1}\frac{3x}{2}$

$S_\infty = \frac{\pi}{2} - \tan^{-1}\frac{3x}{2} = 1$

$\hookrightarrow \cot^{-1}\frac{3x}{2} = 1$

$\hookrightarrow \frac{3x}{2} = \cot 1$

$x = \frac{2}{3}\cot 1$

18. [C] $\tan^2 x + \cot^2 x = 2\cos^2 y$

$\geq 2 \qquad \leq 2$

$\tan^2 x = 1$, $\cos^2 y = 1$ $\quad \cos^2 y + \sin^2 z = 1$

$\sin^2 z = 0$

& $\int_1^3 \frac{t^2}{t^2-4t+8}\,dt = 2\int_1^3 \frac{t^2}{2t^2-8t+16} = 2\int_1^3 \frac{t^2}{t^2+(4-t)^2}$ apply king.

19. [C]

20. [B] $(x\hat{i}+y\hat{j})\cdot(6\hat{j}-4\hat{i}+x\hat{i}+y\hat{j}) = 3$

$x^2+y^2-4x+6y-3=0$ $\quad$ Centre $\equiv (2,-3)$

$r = 4$

$|x\hat{i}+2\hat{i}-3\hat{j}|_{max} = 2(2+\sqrt{13})$

21. 150

$(1+x+x^2+x^3)^{100} = a_0 + a_1 x + \cdots + a_{300} x^{300}$

By Differentiate Both Side

$100(1+x+x^2+x^3)^{99}(1+2x+3x^2) = a_1 + 2a_2 x + \cdots + 300 a_{300} x^{299}$

Put $x=1$

$100 \cdot 4^{99} \cdot 6 = a_1 + 2a_2 + 3a_3 + \cdots + 300 a_{300}$ — (1)

Put $x=1$ $\quad 4^{100} = a_0 + a_1 + a_2 + \cdots + a_{300}$ — (2)

By Comparing eq (1) & eq (2) $\sum_{r=0}^{300} r \cdot a_r = 150 \cdot K$

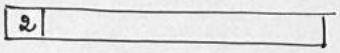
22. $g'(0) = 1,\ g''(0) = 0,\ g'''(0) = -2018$

Ans $\boxed{-2017}$

23. 13

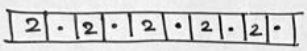
Prime No = 2, 3, 5, 7

Total possible outcome



1×4^9

favourable outcomes



$= 2^5$

Required Prob $= \frac{2^5}{4^9} = \frac{1}{2^{13}} = \frac{1}{2^K}$ $\boxed{K=13}$ Ans

24. Ans 4

$\exp\left(\lim_{x\to 0} \frac{ab}{x^2}\left(\sin\frac{2x^2}{a} + \cos\frac{3x}{b} - 1\right)\right) = e^3$

25. $\boxed{10 \rightarrow \text{Ans}}$