JEE MAIN 2026

Sample Paper - 19

Time Allowed: 3 hours **Maximum Marks:** 300

General Instructions:

1. The test consists of total 75 questions.

2. Each subject (PCM) has 25 questions.

3. Each subject divided into two sections. Section A consists of 20 multiple-choice questions & Section B consists of 5 numerical value-type questions.

4. Marking Scheme:

- Section A (MCQs): +4 marks for each correct answer, -1 mark for each incorrect answer, 0 marks for unattempted.
- Section B (Numerical): +4 marks for each correct answer, 0 marks for incorrect or unattempted.

5. Any textual, printed, or written material, mobile phones, calculator etc. is not allowed for the students appearing for the test.

6. All calculations/written work should be done in the rough sheet is provided with the Question Paper.

MATHEMATICS

Max Marks: 100

SECTION-I (SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

1. $\lim\limits_{x\to 0}\dfrac{e^{x^2}-\cos x}{\sin^2 x}$ is equal to

1) 3 **2)** 3/2 **3)** 5/4 **4)** 2

2. $\int \dfrac{\cos x}{\sin^2 x+4\sin x+5}dx$ equals

1) $\tan^{-1}(\sin x)+c$ **2)** $\tan^{-1}(\sin x+2)+c$

3) $\tan^{-1}(\sin x+1)+c$ **4)** $\tan^{-1}(\cos x)+c$

3. The mean and variance of a set of 15 numbers are 12 and 14 respectively. The mean and variance of another set of 15 numbers are 14 and σ^2 respectively. If the variance of all the 30 numbers in the two sets is 13, then $3\sigma^2$ is equal to

1) 33 **2)** 36 **3)** 30 **4)** 27

4. If 7^{th} and 13^{th} terms of an A.P be 34 and 64 respectively, then its 18^{th} term is

1) 87 **2)** 88 **3)** 89 **4)** 90

5. If the third term of a G.P is 4 then the product of its first 5 terms is

1) 4^3 **2)** 4^4 **3)** 4^5 **4)** 4^2

6. If x be real, then the minimum value of $x^2-8x+17$ is

1) -1 **2)** 0 **3)** 1 **4)** 2

7. Let ω be a complex number such that $2\omega+1=z$, where $z=\sqrt{-3}$. If $\begin{vmatrix}1 & 1 & 1\\ 1 & -\omega^2-1 & \omega^2\\ 1 & \omega^2 & \omega^7\end{vmatrix}=3k$, then 3k is equal to

1) $-3z$ **2)** 3z **3)** -3 **4)** +3

8. Let A be a point on the line $\vec{r}=(1-3\mu)\hat{i}+(\mu-1)\hat{j}+(2+5\mu)\hat{k}$ and $B=(3,2,6)$ be a point in the space. Then the value of '4μ' for which the vector $\overline{AB}$ is parallel to plane x-4y+3z=1 is:

1) 1 **2)** $\frac{1}{8}$ **3)** $\frac{1}{2}$ **4)** -1

9. If the system of equations $x+y+z=5, x+2y+3z=9, x+3y+\alpha z=\beta$ has infinitely many solutions, then $\beta-2\alpha$ equals:

1) 21 **2)** 3 **3)** 18 **4)** 5

10. Twice the distance of the point $(1,0,2)$ from the point of intersection of the line $\frac{x-2}{3}=\frac{y+1}{4}=\frac{z-2}{12}$ and the plane $x-y+z=16$ is

1) $2\sqrt{14}$ **2)** 8 **3)** $3\sqrt{21}$ **4)** 26

11. Consider the following statements:

S1: For the line $2x+3y-7=0$, the points origin and $(1,1)$ are on the same side.

S2: Two points (x_1,y_1) and (x_2,y_2) lie on the same side of the line $ax+by+c=0$ $(a,b,c \in R-\{0\})$ if $(ax_1+by_1+c)(ax_2+by_2+c)>0$

1) Both statements are true **2)** Both statements are false

3) S1 is true and S2 is false **4)** S1 is false and S2 is true

12. There are 10 seats in the first row of a theatre of which 4 are to be occupied. The number of ways of arranging 4 persons so that no two persons sit side by side is

1) 840 **2)** 600 **3)** 276 **4)** 640

13. Let the pairs $(\vec{p},\vec{q})$ and $(\vec{r},\vec{s})$ be such that each pair determines a plane. Then the planes are parallel, if

1) $(\vec{p}\times\vec{q}).(\vec{r}\times\vec{s})=0$ **2)** $(\vec{p}\times\vec{q})\times(\vec{r}\times\vec{s})\neq 0$

3) $(\vec{p}\times\vec{q}).\vec{r}=0$ & $(\vec{p}\times\vec{q}).\vec{s}=0$ **4)** $(\vec{p}\times\vec{q}).\vec{r}\neq 0$

14. An urn contains 7 green and 5 yellow balls. Two balls are drawn at a time. The probability that both balls are of the same colour is

1) $\frac{1}{33}$ **2)** $\frac{5}{33}$ **3)** $\frac{7}{22}$ **4)** $\frac{31}{66}$

15. Match the range of functions given in Column I with column II.

Column I		Column II	
A	$f(x)=\lvert sin\ x\rvert,\ x\epsilon R$	**p**	$[0,2]$
B	$f(x)=\lvert 3-x\rvert+\lvert 2+x\rvert, x\in[0,4]$	**q**	$[5,7]$
C	$f(x)=x^4+2x^2+5, x\in[-1,1]$	**r**	$[0,1]$
D	$f(x)=\cos^2 x,\ x\epsilon R$	**s**	$[5,8]$

1) $(A)\to(p),(B)\to(s),(C)\to(q),(D)\to(r)$

2) $(A)\to(q),(B)\to(p),(C)\to(r),(D)\to(s)$

3) $(A)\to(p),(B)\to(q),(C)\to(s),(D)\to(r)$

4) $(A)\to(r),(B)\to(q),(C)\to(s),(D)\to(r)$

16. The set of values of the parameter 'a' for which the function; $f(x)=8ax-a\sin 6x-7x-\sin 5x$ increases $\forall\ x\in R$ and has no critical points is

1) $[-1,1]$ **2)** $(-\infty,-6)$ **3)** $(-\infty,-6]$ **4)** $(6,\infty)$

17. Coefficient of x^4 in $5x^2(1+x^2)^{11}$ is

1) 22 **2)** 33 **3)** 44 **4)** 55

18. If r_1 and r_2 are the radii of smallest and largest circles which pass through $(5,6)$ and touch the circle $(x-2)^2+y^2=4$, then $4r_1r_2$ is

1) $\frac{4}{41}$ **2)** 41 **3)** $\frac{5}{41}$ **4)** $\frac{41}{6}$

19. If $f(x)=\sin^3 x+\log_e(x^2+1)$, then $f'(x)$ is

1) $3\sin^2 x.\cos x+\frac{2x}{1+x^2}$ **2)** $3\sin^2 x.\cos x+\frac{x}{1+x^2}$

3) $2\sin^2 x.\cos x+\frac{2x}{1+x^2}$ **4)** $3\sin^2 x.\cos x+\frac{4x}{1+x^2}$

20. The function $y=f(x)$ is the solution of the differential equation $\frac{}{dx}+\frac{xy}{x^2-1}=\frac{^4+2}{\sqrt{1-x^2}}in(-1,1)$ satisfying $f(0)=0$. Then $2\int_{-\sqrt{3}/2}^{\sqrt{3}/2} f(x)dx$ is

1) $\frac{2\pi}{3}+\frac{\sqrt{3}}{2}$ **2)** $\frac{2\pi}{3}-\frac{\sqrt{3}}{2}$ **3)** $\frac{\pi}{6}-\frac{\sqrt{3}}{4}$ **4)** $\frac{\pi}{6}-\frac{\sqrt{3}}{2}$

SECTION-II(NUMERICAL VALUE TYPE)

This section contains **5Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** andIf answer is from **10.5** and less than **11** round off is **11).**

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

21. Consider the cube in the first octant with sides OP, OQ and OR of length 1, along the x-axis, y-axis and z-axis, respectively, where O(0,0,0) is the origin. Let $S\left(\frac{1}{2},\frac{1}{2},\frac{1}{2}\right)$ be the centre of the cube and T be the vertex of the cube opposite to the origin O such that S lies on the diagonal OT. If $\vec{p}=\overrightarrow{SP},\vec{q}=\overrightarrow{SQ},\vec{r}=\overrightarrow{SR}\ and\ \vec{t}=\overrightarrow{ST}$, then the value of $2\left|(\vec{p}\times\vec{q})\times(\vec{r}\times\vec{t})\right|$ is _____.

22. Twice the area (in sq. units) of the region $\{(x,y);x\geq 0,x+y\leq 3,x^2\leq 4y\ and\ \ y\leq 1+\sqrt{x}\}$ is

23. The Middle term in the expansion of $(1+x^2)^4$ (when $x=2$) is _____

24. The equation of directrix of parabola $y^2=4(x-2)$ is $x=$ ____

25. Number of permutations of the word IITJEE is

PHYSICS **Max Marks: 100**

SECTION-I(SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

26. An expression of energy density is given by $u=\frac{\alpha}{\beta}\sin\left(\frac{\alpha x}{kt}\right)$. Where α,β are constants, x is displacement, k is Boltzmann constant and t is the absolute temperature. The dimensions of β will be:

1) $\left[ML^2T^{-2}\theta^{-1}\right]$ **2)** $\left[M^0L^2T^{-2}\right]$ **3)** $\left[M^0L^0T^0\right]$ **4)** $\left[M^0L^2T^0\right]$

27. Given below are two statements. One is labeled as Assertion A and the other is labeled as Reason R.

Assertion A: Two identical balls A and B thrown with same velocity 'u' at two angles with horizontal attained the same range R. If A and B reached the maximum height h_1 and h_2 respectively, then $R=4\sqrt{h_1h_2}$

Reason R: product of heights.

$$h_1h_2=\left(\frac{u^2\sin^2\theta}{2g}\right).\left(\frac{u^2\cos^2\theta}{2g}\right)$$

Choose the CORRECT answer:

1) Both A and R are true and R is the correct explanation of A

2) Both A and R are true and R is NOT the correct explanation of A

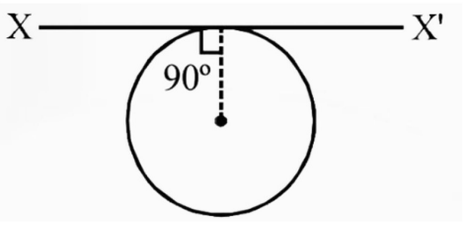
3)A is true but R is false

4) A is false but R is true

28. A wedge of mass M = 4m lies on a frictionless plane. A particle of mass m approaches the wedge with speed v towards inclined side. There is no friction between the particle and the plane or between the particle and the wedge. The maximum height climbed by the particle on the wedge is given by:

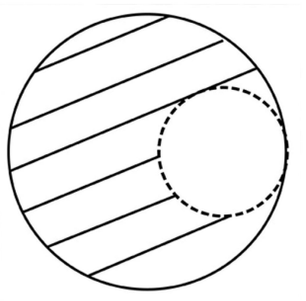
1) $\frac{v^2}{g}$ **2)** $\frac{2v^2}{7g}$ **3)** $\frac{2v^2}{5g}$ **4)** $\frac{v^2}{2g}$

29. A thin wire of length L and uniform linear mass density ρ is bent into a circular loop with centre at O as shown. The moment of inertia of the loop about the axis XX' is



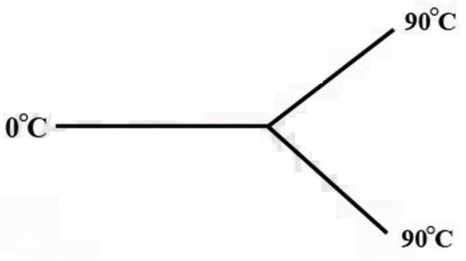
1) $\frac{\rho L^3}{8\pi^2}$ **2)** $\frac{\rho L^3}{16\pi^2}$ **3)** $\frac{5\rho L^3}{16\pi^2}$ **4)** $\frac{3\rho L^3}{8\pi^2}$

30. From a solid sphere of mass M and radius R, a spherical portion of radius R/2 is removed, as shown in the figure. Taking gravitational potential V = 0 at $r=\infty$, the potential at the centre of the cavity thus formed is:



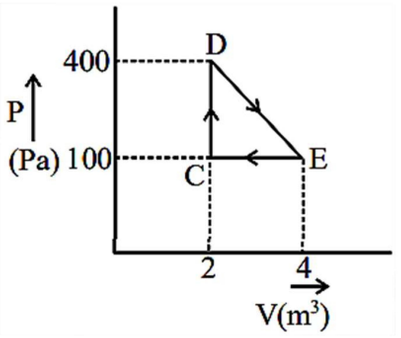
1) $\frac{-2GM}{3R}$ **2)** $\frac{-2GM}{R}$ **3)** $\frac{-GM}{2R}$ **4)** $\frac{-GM}{R}$

31. Three rods made of same material and having the same cross-section have been joined as shown in the figure. Each rod is of the same length. The left and right ends are kept at 0^0C and 90^0C respectively. The temperature of the junction of three rods will be



1) 45^0C **2)** 60^0C **3)** 30^0C **4)** 20^0C

32. A thermodynamic system is taken through cyclic process. The total work done in the process is:

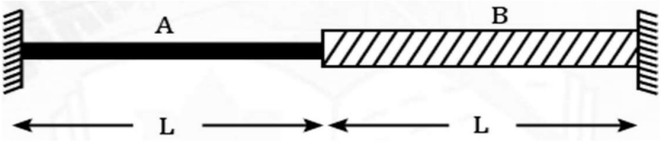


1) 100J **2)** 300J **3)** 200J **4)** zero

33. The displacement of simple harmonic oscillator after 3 seconds starting from its mean position is equal to half of its amplitude. The time period of harmonic motion is:

1) 6s **2)** 8s **3)** 12s **4)** 36s

34. A wire of length 2L, is made by joining two wires A and B of same length but different radii r and 2r and made of the same material. It is vibrating at a frequency such that the joint of the two wires forms a node. If the number of antinodes in wire A is p and that in B is q then the ratio p : q is:



1) 3 : 5 **2)** 4 : 9 **3)** 1 : 2 **4)** 1 : 4

35. Choose the incorrect statement :

A) The electric lines of force entering into a Gaussian surface provide negative flux.

B) A charge 'q' is placed at the centre of a cube. The flux through all the faces will be the same.

C) In a uniform electric field net flux through a closed Gaussian surface containing no net charge, is zero.

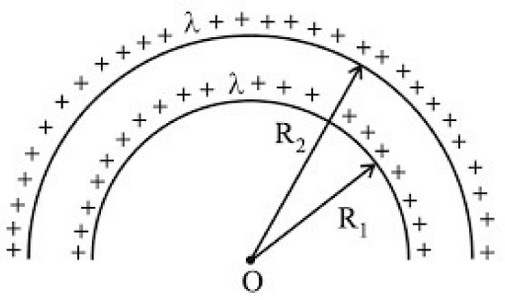
D) When electric field is parallel to the Gaussian surface, it provides a finite non-zero flux.

Choose the most appropriate answer from the options given below

1) (C) and (D) only **2)** (B) and (D) only

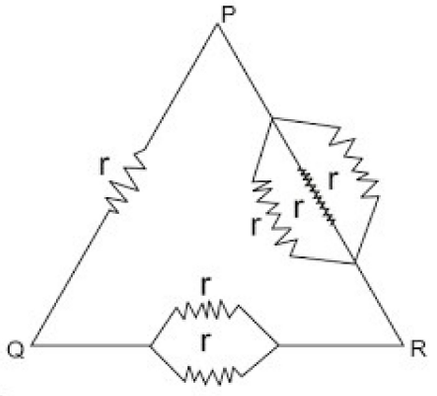
3) (D) only **4)** (A) and (C) only

36. The electric potential at the centre of two concentric half rings of radii R_1 and R_2, having same linear charge density λ is



1) $\frac{2\lambda}{\varepsilon_0}$ **2)** $\frac{\lambda}{2\varepsilon_0}$ **3)** $\frac{\lambda}{4\varepsilon_0}$ **4)** $\frac{\lambda}{\varepsilon_0}$

37. Six equal resistances are connected between points P, Q and R as shown in figure. Then net resistance will be maximum between:



1) P and R **2)** P and Q **3)** Q and R **4)** any two points

38. A proton and an α-particle, having kinetic energies K_p and K_α respectively, enter into a magnetic field at right angles. The ratio of the radii of trajectory of proton to that of α-particle is 2:1. The ratio of $K_p:K_\alpha$ is:

1) 1:8 **2)** 8:1 **3)** 1:4 **4)** 4:1

39. Given below are two statements:

Statement-I: Susceptibilities of paramagnetic and ferromagnetic substances increase with decrease in temperature.

Statement-II: Diamagnetism is a result of orbital motion of electrons developing magnetic moments opposite to the applied magnetic field.

Choose the CORRECT answer from the options given below:

1) Both statement-I and statement-II are true.

2) Both statement-I and statement-II are false.

3) Statement –I is true but statement-II is false.

4) Statement –I is false but statement-II is true.

40. A capacitor of capacitance $100\mu F$ is charged to a potential of 12 V and connected to 6.4 mH inductor to produce oscillations. The maximum current in the circuit would be:

1) 1.2 A **2)** 1.5 A **3)** 3.2 A **4)** 2.0 A

41. A plane electromagnetic wave of frequency 35MHz travels in free space along positive X-direction. At a particular point (in space and time) $\vec{E} = 9.6\hat{j}V/m$. The value of magnetic field at this point is:

1) $3.2\times10^{-8}\hat{k}T$ **2)** $3.2\times10^{-8}\hat{i}T$ **3)** $9.6\hat{j}T$ **4)** $9.6\times10^{-8}\hat{k}T$

42. The image of an illuminated square is obtained on a screen with the help of a converging lens. The distance of the square from the lens is 40 cm. The area of the image is 9 times that of the square. The focal length of the lens is:

1) 36 cm **2)** 27 cm **3)** 60 cm **4)** 30 cm

43. a metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V_0. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential becomes $\frac{V_0}{4}$. The threshold wavelength for this metallic surface will be-

1) $\frac{\lambda}{4}$ **2)** 4λ **3)** $\frac{3}{2}\lambda$ **4)** 3λ

44. Which of the following nuclear fragments corresponding to nuclear fission between neutron $\left({}_{0}^{1}n\right)$ and uranium isotope $\left({}_{92}^{235}U\right)$ is correct.

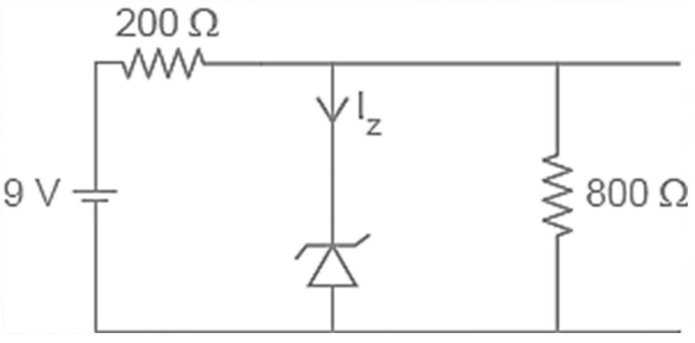
1) ${}_{56}^{144}Ba+{}_{36}^{89}Kr+4{}_{0}^{1}n$

2) ${}_{56}^{140}Xe+{}_{38}^{94}Sr+3{}_{0}^{1}n$

3) ${}_{51}^{153}Sb+{}_{41}^{99}Nb+3{}_{0}^{1}n$

4) ${}_{56}^{144}Ba+{}_{36}^{89}Kr+3{}_{0}^{1}n$

45. The reverse breakdown voltage of a Zener diode is 5.6 V in the given circuit. The current I_z through the Zener is:



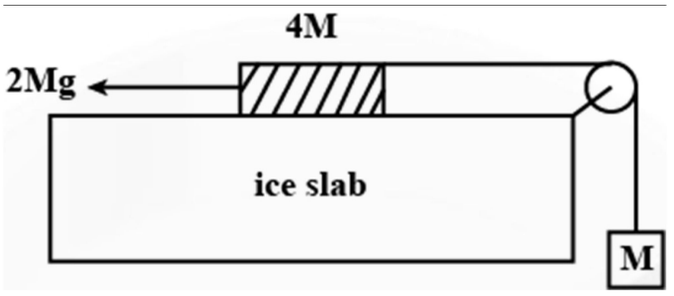
1) 10 mA **2)** 17 mA **3)** 15 mA **4)** 7 mA

SECTION-II(NUMERICAL VALUE TYPE)

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** andIf answer is from **10.5** and less than **11** round off is **11**).

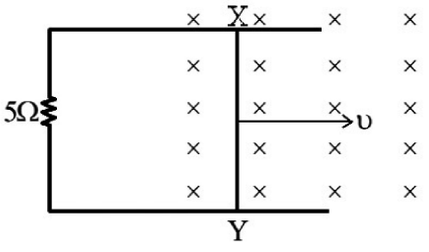
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

46. A hanging mass M is connected to a four times bigger mass by using a string-pulley arrangement, as shown in the figure. The bigger mass is placed on a fixed horizontal ice-slab and being pulled by 2 Mg force. In this situation. Tension in the string is $\frac{x}{5}$ Mg for x = _____. Neglect mass of the string and friction of the block (bigger mass) with ice slab. (Given g = acceleration due to gravity)



47. A cylinder of height 20m is completely filled with water. The velocity of efflux of water $\left(in\ ms^{-1}\right)$ through a small hole on the side wall of the cylinder near its bottom is $\left(take\ g = 10m/s^2\right)$

48. A 1m long metal rod XY completes the circuit as shown in figure. The plane of the circuit is perpendicular to the magnetic field of flux density 0.15 T. If the resistance of the circuit is 5Ω, the force needed to move the rod in direction, as indicated, with a constant speed of 4 m/s will be _____ 10^{-3} N.



49. In a Young's double slit experiment, the intensity at a point is $\left(\frac{1}{4}\right)^{th}$ of the maximum intensity, the minimum distance of the point from the central maximum is _____ μm. (Given λ=600 nm, d=1.0 mm, D=1.0 m)

50. If Rydberg's constant is R, the longest wavelength of radiation in Paschen series will be $\frac{\alpha}{7R}$, where α= _____.

CHEMISTRY

Max Marks: 100

SECTION-I (SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

51. With in each pair of elements F and Cl, S and Se, and Li and Na respectively, the elements that release more energy upon an electron gain enthalpy are

1) F, Se and Na **2)** F, S and Li **3)** Cl, S and Li **4)** Cl, Se and Na

52. Pick out the iso-structural pairs from the following

I. CH_3^+ II. H_3O^+ III. NH_3 IV. CH_3^-

1) I and II **2)** I and IV **3)** I and III **4)** III and IV

53. **Statement -1:** MnO_2 is used for preparation of $KMnO_4$.

Statement -2 : MnO_2 is reduced in the presence of O_2 and KOH to prepare $KMnO_4$

1) Statement-1 is true, Statement -2 is true; statement -2 is a correct explanation for Statement-1.

2) Statement-1 is true, Statement -2 is true; statement -2 is NOT a correct explanation for Statement-1.

3) Statement-1: is true, Statement-2 is False.

4) Statement-1 is False, Statement-2 is True.

54. Match the following

	List –I		**List –I**
P)	$K_4[Fe(CN)_6]$	1)	Coordination Number = 6
Q)	$[Cr(H_2O)_6]Cl_3$	2)	Primary Valency = 2
R)	$Fe(CO)_5$	3)	Secondary Valency = 4
S)	$Na_2[Mn(Cl)_4]$	4)	Primary Valency = 0

Select CORRECT code of your answer.

1) P-2; Q-1;R-4; S-3 **2)** P-4; Q-3; R-1; S-2

3) P-3; Q-2; R-4; S-3 **4)** P-2; Q-1; R-3; S-4

55. Which of the following is correct comparison of most stable intermediate of the following

1) 3° Carbocation < 1° Carbocation **2)** 3° Carbanion > 1° Carbanion

3) 3° Carbocation > 1° Carbocation **4)** 2° Carbanion > Methyl Carbanion

56. Statement I: Aryl halides undergo nucleophilic substitution with ease.
Statement II: The carbon-halogen bond in aryl halides has partial double bond character.

1) Statement I and II are true and statement II is a correct explanation for statement I

2) Statement I and II are true and statement II is not a correct explanation for statement I

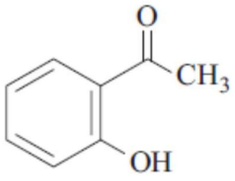
3) Statement I is true, statement II is false

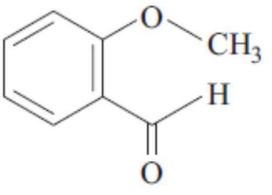
4) Statement I is false, statement II is true

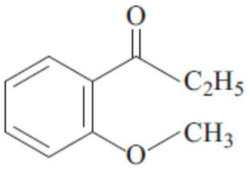
57. Which of the following gives positive Cannizaro reaction?

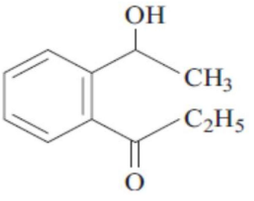
1) Acetaldehye **2)** Formaldehyde **3)** Propanal **4)** Butanal

58. Which of the following given compound gives positive Iodoform test with lower Molecular mass respectively.

1) 

2) 

3) 

4) 

59. Assertion :- p-hydroxybenzoic acid has a lower boiling point than o- hydroxybenzoic acid .
Reason :- o- hydroxybenzoic acid has intramolecular hydrogen bonding

1) A is correct but R is not correct

2) Both A and R are correct but R is not the correct explanation on of A

3) A is not correct but R is correct

4) Both A and R are correct and R is the correct explanation of A

60. Which of the following compound give HVZ reaction?

1) Acetic Acid **2)** Formic Acid **3)** Benzoic Acid **4)** Picric Acid

61. Assertion (A) : Sucrose is a reducing sugar

Reasoning (R) : In Sucrose, glucose and fructose are involved in glycosidic bond formation

1) If both **Assertion** and **Reason** are true and the **Reason** is correct explanation of the Assertion..

2) If both **Assertion** and **Reason** are true but **Reason** is not the correct explanation of Assertion..

3) If **Assertion** is true, but the **Reason** is false.

4) If **Assertion** is false but the **Reason** is true

62. Which of the following orbital has two radial nodes

1) 2s **2)** 4s **3)** 4f **4)** 5d

63. 2 moles of an ideal gas at $27^0 C$ expands isothermally and reversibly from a volume of 4 litres to 40 litres the work done (in KJ) by the gas is

1) $w = -28.72kJ$ **2)** $w = -11.488kJ$

3) $w = -5.736kJ$ **4)** $w = -4.968kJ$

64. The equilibrium constant for the reaction $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$ at temperature T is 4×10^{-4} the value of K_c for the reaction $NO_{(g)} \rightleftharpoons \frac{1}{2}N_{2(g)} + \frac{1}{2}O_{2(g)}$ at the same temperature is

1) 4×10^{-4} **2)** 50 **3)** 2.5×10^{2} **4)** 0.02

65. What is the molar solubility of AgCl in water given that $K_{sp}\ of\ AgCl = 10^{-10} M^2$

1) 10^{-5} **2)** 10^{-6} **3)** $10^{-5.5}$ **4)** 10^{-4}

66. A solution of potassium sulphate in water is electrolysed using inert electrode the products formed at the cathode and anode respectively

1) H_2, O_2 **2)** K, O_2 **3)** $O_2,\ H_2$ **4)** $O_2\ and\ H_2S_2O_8$

67. 6gm of urea (molecular weight =60) was dissolved in 9.9 moles of water of the vapour pressure of pure water is P^0. What would be vapour pressure of the solution is

1) $0.10P^0$ **2)** $1.1P^0$ **3)** $0.90P^0$ **4)** $0.99P^0$

68. Which of the following is incorrect

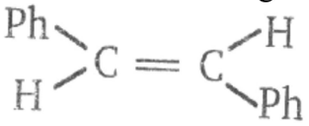
1) Acidic order : $N_2O_5 > P_2O_5 > As_2O_5 > Sb_2O_5 > Bi_2O_5$

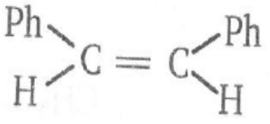
2) Stability: Black-P > Red-P > White -P

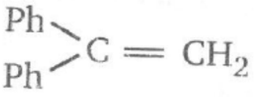
3) Covalent Radius: Po > Te > Se > S > O

4) Ionisation Energy S > O > Se > Te > Po

69. Which of the following compounds exhibit geometrical Isomers

I) 

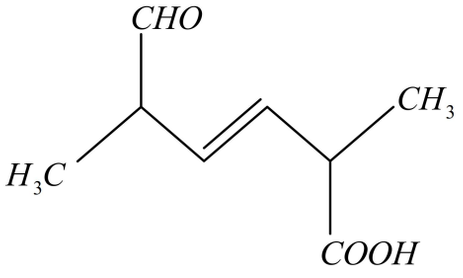
II) 

III) 

IV) 

1) I & III **2)** I & II **3)** II & III **4)** III & IV

70. The IUPAC name for the following compound is:



1) 2, 5-dimethyl-5-carboxy-hex-3-enal

2) 2, 5-dimethyl-6-carboxy-hex-3-enal

3) 2, 5-dimethyl-6-oxo-hex-3-enoic acid

4) 6-formyl-2-methyl-hex-3-enoic acid

SECTION-II (NUMERICAL VALUE TYPE)

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

71. Among the triatomic molecules/ions $BeCl_2$, N_3^-, N_2O, NO_2^+, O_3, SCl_2, ICl_2^-, I_3^- and XeF_2, the total number of linear molecules (s) /ion(s) are [atomic number of S=16,Cl =17 , I=53 and Xe =54]

72. How many groups o/p director in the electrophilic aromatic substitution?

i) $-NH_2$ ii) $-COH$ iii) $-NO_2$ iv) $-COOH$ v) $-OMe$

vi) $-O-\overset{\overset{O}{\|}}{C}-Me$ vii) $-C_2H_5$ viii) $-\overset{\overset{O}{\|}}{C}-NH-Me$ ix) $-SO_3H$

73. Enthalpy of hydration of NaCl is $-785kJ/mole$. If enthalpy of solution is 5kJ/mole the magnitude of lattice energy of NaCl is (in kJ)

74. 4gms of NaOH and 4.9gm H_2SO_4 are dissolved in water and volume is made up to 250ml the P^H of the solution is

75. For the zero order reaction $A \rightarrow B + S$ initial concentration of A is 0.1M. If [A] =0.08M after 10 minutes then half life period is

ANSWER KEY

MATHEMATICS

1	**2**	2	**2**	3	**3**	4	**3**	5	**3**
6	**3**	7	**1**	8	**1**	9	**2**	10	**4**
11	**1**	12	**1**	13	**3**	14	**4**	15	**4**
16	**4**	17	**4**	18	**2**	19	**1**	20	**2**
21	**1**	22	**5**	23	**96**	24	**1**	25	**180**

PHYSICS

26	**4**	27	**1**	28	**3**	29	**4**	30	**4**
31	**2**	32	**2**	33	**4**	34	**3**	35	**3**
36	**2**	37	**2**	38	**4**	39	**1**	40	**2**
41	**1**	42	**4**	43	**4**	44	**4**	45	**1**
46	**6**	47	**20**	48	**18**	49	**200**	50	**144**

CHEMISTRY

51	**3**	52	**4**	53	**3**	54	**1**	55	**3**
56	**4**	57	**2**	58	**1**	59	**3**	60	**1**
61	**4**	62	**4**	63	**2**	64	**2**	65	**1**
66	**1**	67	**4**	68	**4**	69	**2**	70	**3**
71	**7**	72	**4**	73	**790**	74	**7**	75	**25**

SOLUTION
MATHEMATICS

1. $\lim\limits_{x\to0}\dfrac{e^{x^2}-\cos x}{\sin^2 x}=\lim\limits_{x\to0}\dfrac{2xe^{x^2}-\sin x}{2\sin x\cos x}$

   (Using L' Hospital Rule), $\lim\limits_{x\to0}\left(\dfrac{x}{\sin x}e^{x^2}+\dfrac{1}{2}\right)\dfrac{1}{\cos x}=1+\dfrac{1}{2}=\dfrac{3}{2}$

2. Put $\sin x = t$

3. $\sum x_i = 15\times12\ and\ \dfrac{\sum x_i^2}{15}-12^2=14$, And $\sum y_i = 15\times14\ and\ \dfrac{\sum y_i^2}{15}-14^2=\sigma$

   Now $13=\dfrac{(14+144)\times15+(\sigma^2+196)\times15}{30}-13^2 \qquad \Rightarrow 3\sigma^2=30$

4. Use a_n formula to find $a=4$ and $d=5$

5. Take the terms as $4/r^2,\ 4/r,\ 4,\ 4r,\ 4r^2$

6. $x^2-8x+17=(x-4)^2+1$ or differentiate or use formula for minimum of quadratic function.

7. Given, $2\omega+1=z \qquad 2\omega+1=\sqrt{-3}\left[\because z=\sqrt{-3}\right] \qquad \Rightarrow\omega=\dfrac{-1+\sqrt{3}i}{2}$

   Since, ω is cube root of unity. $\qquad \therefore\omega^2=\dfrac{-1-\sqrt{3}i}{2}\ and\ \omega^{3n}=1$

   Now, $\begin{vmatrix}1 & 1 & 1\\ 1 & -\omega^2-1 & \omega^2\\ 1 & \omega^2 & \omega^7\end{vmatrix}=3k \qquad \Rightarrow\begin{vmatrix}1 & 1 & 1\\ 1 & \omega & \omega^2\\ 1 & \omega^2 & \omega\end{vmatrix}=3k$

   $\left[\because 1+\omega+\omega^2=0\ and\ \omega^7=\left(\omega^3\right)^2.\omega=\omega\right]$

   On applying $R_1\to R_1+R_2+R_3$, we get $\begin{vmatrix}3 & 1+\omega+\omega^2 & 1+\omega+\omega^2\\ 1 & \omega & \omega^2\\ 1 & \omega^2 & \omega\end{vmatrix}=3k$

   $\Rightarrow\begin{vmatrix}3 & 0 & 0\\ 1 & \omega & \omega^2\\ 1 & \omega^2 & \omega\end{vmatrix}=3k \qquad \Rightarrow3\left(\omega^2-\omega^4\right)=3k\Rightarrow\left(\omega^2-\omega\right)=k$

   $\therefore k=\left(\dfrac{-\ -\sqrt{3}i}{2}\right)-\left(\dfrac{-\ +\sqrt{3}i}{2}\right)=-\sqrt{3}i=-z$

8. Let A is $(1-3\mu,\mu-1,2+5\mu)$

   $\overline{AB}=(3\mu+2)\hat{i}+(3-\mu)\hat{j}+(4-5\mu)\hat{k}$ which is parallel to plane $x-4y+3z=1$

   $=-8\mu+2=0\Rightarrow\mu=\dfrac{1}{4}\therefore 4\mu=1$

9. $x+y+z=5, \qquad x+2y+3z=9, \qquad x+3y+\alpha z=\beta$

   $D=\begin{vmatrix}1 & 1 & 1\\ 1 & 2 & 3\\ 1 & 3 & \alpha\end{vmatrix}=0\Rightarrow(2\alpha-9)+(3-\alpha)+(3-2)=0 \qquad \Rightarrow\alpha=5$

Now, $D_3=\begin{vmatrix}1&1&5\\1&2&9\\1&3&\beta\end{vmatrix}=0\Rightarrow 2\beta-27+9-\beta+5(3-2)=0\Rightarrow\beta=13\Rightarrow at\ \alpha=5,\beta=13$

10. $\frac{x-2}{3}=\frac{y+1}{4}=\frac{z-2}{12}=\lambda[say].....(i)$

And equation of plane is $x-y+z=16$

Any point on the line (i) is $(3\lambda+2,4\lambda-1,12\lambda+2)$

Let this point of intersection of the line and plane .

$(3\lambda+2)-(4\lambda-1)+(12\lambda+2)=16\quad\therefore 11\lambda=11\Rightarrow\lambda=1$ So, the point of intersection is $(5,3,14)$

Now , distance between the points $(1,0,2)\text{and}(5,3,14)=\sqrt{(5-1)^2+(3-0)^2+(14-2)^2}$

$\sqrt{\quad+144}\quad\sqrt{169}\quad 13$. $\therefore$ Twice the distance =26

11. Substituting the points in the given line gives negative values for both points

12. $\therefore x_1+x_2+x_3+x_4+x_5=3\rightarrow$(remaining) $\therefore {}^{3+5-1}C_{5-1}={}^7C_4={}^7C_3\therefore$ total arrangement

${}^7C_3\times 4!=840$

13. The planes are parallel, the normal of one plane is perpendicular to any vector of the other plane $\vec{p}\times\vec{q}\ and\ \vec{r}$ are parallel.

14. Reqd . prob. $=\frac{7_{c_2}}{12_{c_2}}+\frac{5_{c_2}}{12_{c2}}\qquad=\frac{21+10}{66}=\frac{31}{66}$

15. A) $f'(x)=(1-x)(2x+1)e^{x(1-x)}\geq 0$ range is $[0,1]$

B) $f(x)=\begin{cases}1-2x & x<-2\\ 5 & -2\leq x<3\\ 2x-1 & x\geq 3\end{cases}$ Min. value of f(x) =5

Max. value of f(x)=2(4)-1=7

C) $f(x)=(x^2+1)^2+4$ Minimum at x = 0

D) $f'(x)=2x^3(2-x^2)e^{-x^2}\Rightarrow$ Decreasing in [-1,0]

16. $f(x)=8ax-a\sin 6x-7x-\sin 5x$

$f'(x)=8a-6a\cos 6x-7-5\cos 5x=8a-7-6a\cos 6x-5\cos 5x$

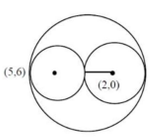
$f(x)$ is an increasing function

$f'(x)>0\therefore 8a-7>6a+5$ (no critical points) $\Rightarrow 2a>12\quad a>6\quad a\in(6,\infty)$

17. $5x^2\left(1+{}^{11}C_1x^2+...\right)$

18. $(x-2)^2+y^2=4$ Centre is $(2,0)$ and radius =2

Distance between $(2,0)$ and $(5,6)$ is $\sqrt{9+36}=3\sqrt{5}$



$\therefore r_1r_2=\frac{(\sqrt{5}-)}{2}\frac{(\sqrt{5}+)}{2}=\frac{41}{4}\therefore 4r_1r_2=41$

19. $f'(x) = 3\sin^2 x.\cos x + \dfrac{2x}{1+x^2}$

20. $\dfrac{dy}{dx} + \dfrac{x}{x^2-1}y = \dfrac{x^4+2x}{\sqrt{1-x^2}}$

The I. F. of this differential equation is $e^{\int \frac{x}{x^2-1}dx} = e^{-\int \frac{x}{1-x^2}dx} = e^{\frac{1}{2}\log(1-x^2)} = \sqrt{1-x^2}$

The solution is given by $\sqrt{1-x^2}\int \dfrac{x(x^3+2)}{\sqrt{1-x^2}}\sqrt{1-x^2}$ $\lambda\int(x^4+2x)dx + \lambda = \dfrac{x^5}{5} + x^2 + \lambda$

At $y(0) = 0 \Rightarrow \lambda = 0 \Rightarrow y\sqrt{1-x^2} = \dfrac{x^5}{5} + x^2$ $\displaystyle\int_{-\sqrt{3}/2}^{\sqrt{3}/2} \frac{\frac{x^5}{5}+x^2}{\sqrt{1-x^2}}dx = \int_{-\sqrt{3}/2}^{\sqrt{3}/2} \frac{x^2}{\sqrt{1-x^2}}dx$

(The other part is odd) $= 2\displaystyle\int_0^{\sqrt{3}/2} \frac{x^2}{\sqrt{1-x^2}}dx$

Let $x = \sin\theta$, we get $I = 2\displaystyle\int_0^{\pi/3} \frac{\sin^2\theta}{\cos\theta}\cos\theta\, d\theta = 2\int_0^{\pi/3} \sin^2\theta d\theta = \int_0^{\pi/3}(1-\cos 2\theta)\,d\theta$

$= \theta - \dfrac{\sin 2\theta}{2}\Big|_0^{\pi/3} = \dfrac{\pi}{3} - \dfrac{\sqrt{3}}{4}$ $\therefore 2I = \dfrac{2\pi}{3} - \dfrac{\sqrt{3}}{2}$

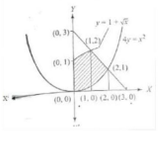
21. Point $S\left(\dfrac{1}{2},\dfrac{1}{2},\dfrac{1}{2}\right)$, Point $T(1,1,1)$

$\vec{p} = \overrightarrow{SP} = \dfrac{\hat{i}-\hat{j}-\hat{k}}{2}$, $\vec{q} = \overrightarrow{SQ} = \dfrac{-\hat{i}+\hat{j}-\hat{k}}{2}$, $\vec{r} = \overrightarrow{SR} = \dfrac{-\hat{i}-\hat{j}+\hat{k}}{2}$, $\vec{t} = \overrightarrow{ST} = \dfrac{\hat{i}+\hat{j}+\hat{k}}{2}$

Now $\vec{p}\times\vec{q} = \dfrac{\hat{i}+\hat{j}}{2}$ $\vec{r}\times\vec{t} = \dfrac{-\hat{i}+\hat{j}}{2}$, Now $(\vec{p}\times\vec{q})(\vec{r}\times\vec{t}) = \dfrac{\hat{k}}{2}$

22. Let $I = \displaystyle\int_0^1 (1+\sqrt{x})dx + \int_1^2 (3-x)dx - \int_0^2 \frac{x^2}{4}dx$

$= \left[x + \dfrac{x^{3/2}}{3/2}\right]_0^1 + \left[3x - \dfrac{x^2}{2}\right]_1^2 - \left[\dfrac{x^3}{12}\right]_0^2 = \left(1+\dfrac{2}{3}\right) + \left(6-2-3+\dfrac{1}{2}\right) - \left(\dfrac{8}{12}\right)$



$= \dfrac{5}{3} + \dfrac{3}{2} - \dfrac{2}{3} = 1 + \dfrac{3}{2} = \dfrac{5}{2} sq.\text{unit}$ $\therefore 2I = 5$

23. $(1+x^2)^4$: the middle terms is the third term $= {}^4C_2 x^4 = 96$ when $x = 2$

24. Vertex is (2,0), a = 1 Directrix is x = 1

25. $\dfrac{6!}{2!2!}$

26. $\sin\left(\frac{\alpha x}{kt}\right)$=Dimensionless

$\therefore \frac{\alpha[L]}{[ML^2T^{-2}]}=[M^0L^0T^0] \Rightarrow \alpha=[ML^1T^{-2}]$

$\frac{\alpha}{\beta}=\frac{Energy}{Volume}=\frac{[ML^2T^{-2}]}{[L^3]} \Rightarrow \beta=\frac{[ML^1T^{-2}][L^3]}{ML^2T^{-2}}$

$=[M^0L^2T^0]$

27. We know that if range is same for two angle of projection, then these angle must be complementary.

Let first angle of projection be 'θ' then second will be $(90-\theta)$

$\therefore h_1=\frac{u^2\sin^2\theta}{2g}$ and $h=\frac{u^2\sin^2(90-\theta)}{2g}=\frac{u^2\cos^2\theta}{2g}$

$\therefore h_1h_2=\frac{u^2\sin^2\theta}{2g}.\frac{u^2\cos^2\theta}{2g}$. So, reason is correct

$\Rightarrow \sqrt{h\,h_2}=\frac{u^2\sin\theta\cos\theta}{2g} \Rightarrow 4\sqrt{h_1h_2}=\frac{4u^2\sin\theta\cos\theta}{2g}$

$\Rightarrow 4\sqrt{h\,h_2}=\frac{u^2(\sin\theta\cos\theta)}{g} \Rightarrow 4\sqrt{h_1h_2}=\frac{u^2\sin 2\theta}{g}=R$

So, assertion is correct and reason is correct explanation of assertion.

28. $mv=(m+M)V'$

Or $v=\frac{mv}{m+M}=\frac{mv}{m+4m}=\frac{v}{5}$

Using conservation of ME, we have

$\frac{1}{2}mv^2=\frac{1}{2}(m+4m)\left(\frac{v}{5}\right)^2+mgh$ or $h=\frac{2}{5}\frac{v^2}{g}$

29. About the diameter of the circular loop (ring)

$I=\frac{1}{2}MR^2$

Using parallel axis theorem

Moment of inertia of the loop about XX' axis

$I_{xx'}=\frac{MR^2}{2}+MR^2=\frac{3}{2}MR^2$

Here mass $M=L\rho$ and radius $R=\frac{L}{2\pi}$;

$\therefore I_{XX'}=\frac{3}{2}(L\rho)\left(\frac{L}{2\pi}\right)^2=\frac{3L^3\rho}{8\pi^2}$

30. Due to complete solid sphere, potential point P

$V_{sphere}=\frac{-GM}{2R^3}\left[3R^2-\left(\frac{R}{2}\right)^2\right]$

$$=\frac{-GM}{2R^3}\left(\frac{11R^2}{4}\right)=-11\frac{GM}{8R}$$

Due to cavity part potential at point P

$$V_{capacity}=-\frac{3}{2}\frac{\frac{M}{8}}{\frac{R}{2}}=-\frac{3GM}{8R}$$

So potential at the centre of cavity

$$=V_{sphere}-V_{capacity}=-\frac{11GM}{8R}-\left(-\frac{3}{8}\frac{GM}{R}\right)=\frac{-GM}{R}$$

31. $T=\frac{(T_1+T_2+T_3)}{3}=60$

32. work done=Area of graph

$$W=\frac{1}{2}(400-100)(4-2)$$

$$W=300J$$

33. Time taken by the harmonic oscillator to move from mean position to half of the amplitude is $\frac{T}{12}$

$$so,\ \frac{T}{12}=3$$

$$T=36\sec$$

34. $f=\frac{n}{21}\sqrt{\frac{T}{\mu}}$, where n = nth harmonic and is equal to number of antinodes.

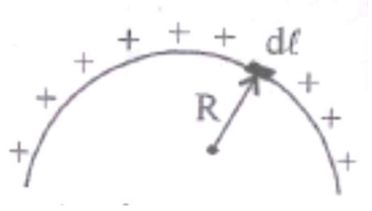
$$f_A=\frac{}{21}\sqrt{\frac{T}{\rho A_0}}\Rightarrow f_B=\frac{}{21}\sqrt{\frac{T}{4\rho A_0}}\qquad \therefore\frac{f_A}{f_B}=\frac{2p}{q}\Rightarrow\frac{p}{q}=\frac{1}{2}$$

35. When electric field is parallel to surface, it makes 90^0 angle with area vector so flux = 0

As $\phi=\bar{E}.\bar{A}=EA\cos 90^0=0$

36. $dv=\frac{1}{4\pi\in_0}\frac{\lambda d\ell}{R};v\int dv=\frac{1}{4\pi\in_0}\frac{\lambda\ell}{R}$

Potential at centre, $V=V_2+V_1$ $\Rightarrow V=\frac{(\lambda.\pi R_2)}{4\pi\varepsilon_0 R_2}+\frac{(\lambda.\pi R_1)}{4\pi\varepsilon_0 R_1}=\frac{\lambda}{2\varepsilon_0}$



37. Resistance between P and Q $r_{PQ}=r\|\left(\frac{r}{3}+\frac{r}{2}\right)=\frac{r\times\frac{5}{6}r}{r+\frac{5}{6}r}=\frac{5}{11}r$

Resistance between Q and R $r_{QR}=\frac{r}{2}\|\left(r+\frac{r}{3}\right)=\frac{\frac{r}{2}\times\frac{4}{3}r}{\frac{r}{2}\times\frac{4}{3}}=\frac{4}{11}r$

Resistance between P and R $r_{PR}=\frac{r}{3}\|\left(\frac{r}{2}+r\right)=\frac{\frac{r}{3}\times\frac{3}{2}r}{\frac{r}{3}\times\frac{3}{2}r}=\frac{3}{11}r$

Hence, it is clear that r_{PQ} is maximum.

38. $F=\frac{mV^2}{r}\ and\ F=qVB\ \therefore\frac{mV^2}{r}=qVB\Rightarrow r=\frac{mV}{qB}$

$or, r=\frac{\sqrt{2mK}}{qB}\qquad\left(\because p=mV=\sqrt{2mK}\right)\quad\Rightarrow\frac{r^2q^2B^2}{2m}=K$

$k_p=\frac{r_p^2q_p^2B^2}{2m_p}\text{ and }k_\alpha=\frac{r_\alpha^2q_\alpha^2B^2}{2m_\alpha}\quad\therefore\frac{K_p}{K_\alpha}=\frac{r_p^2q_p^2m_\alpha}{r_\alpha^2q_\alpha^2m_p}=\left(\frac{2}{1}\right)^2\left(\frac{1}{2}\right)^2\left(\frac{4}{1}\right)\text{ or, }\frac{K_p}{K_\alpha}=4:1$

39. According to Curie's law, magnetic susceptibility is inversely proportional to temperature for a fixed value of external magnetic field i.e. $X=\frac{C}{T}$

The same is applicable for ferromagnet & the relation is given as

$X=\frac{C}{T-T_C}\left(T_C\text{ is curie's Temperature}\right)$

Dimagnetism is due to non-cooperative behaviour of orbiting electrons when exposed to external magnetic field.

40. For LC oscillation, Maximum current, $I=Q_0.\omega=\frac{CV}{\sqrt{LC}}=V\sqrt{\frac{C}{L}}$

$\left[\because\omega=\frac{1}{\sqrt{LC}}\&Q_0-CV\right]=12\sqrt{\frac{100\times10^{-6}}{6.4\times10^{-3}}}=1.5A$

41.

$\frac{E}{B}=C$

$\frac{E}{B}=3\times10^8$

$B=\frac{E}{3\times10^8}=\frac{9.6}{3\times10^8}$

$B=3.2\times10^{-8}T$

$\hat{B}=\hat{v}\times\hat{E}$

$=\hat{i}\times\hat{j}=\hat{k}$

$so,\ \vec{B}=3.2\times10^{-8}\hat{k}T$

42. If side of object square = ℓ
and side of image square ℓ'

From question, $\frac{\ell'^2}{\ell^2}=9 or \frac{\ell'}{\ell}=3$

i.e., magnification m =3,

u = -40 cm

$v=3\times40=120\,cm$

f = ?

From formula, $\frac{1}{v}-\frac{1}{u}=\frac{1}{r}\Rightarrow\frac{1}{120}-\frac{1}{-40}=\frac{1}{f}$

Or, $\frac{1}{f}=\frac{1}{120}+\frac{1}{40}=\frac{1+3}{120}\therefore f=30\,cm$

43. From the Einstein's photoelectric equation

$eV_0=\frac{hc}{\lambda}-\phi_0=\frac{hc}{\lambda}-\frac{hc}{\lambda_0}\quad ...(i)$

$\&\ \frac{eV_0}{4}=\frac{hc}{2\lambda}-\frac{hc}{\lambda_0}\quad ...(ii)$

$\Rightarrow\frac{1}{4}\left(\frac{hc}{\lambda}-\frac{hc}{\lambda_0}\right)=\frac{hc}{2\lambda}-\frac{hc}{\lambda_0}$

$\Rightarrow\frac{1}{\lambda_0}-\frac{1}{4\lambda_0}=\frac{1}{2\lambda}-\frac{1}{4\lambda}\Rightarrow\frac{3}{4\lambda_0}=\frac{1}{4\lambda}$

$\Rightarrow\lambda_0=3\lambda$

44. Nuclear fission between neutron $\left({}_0^1n\right)$ and uranium isotope ${}_{92}^{235}U$

${}_{92}^{235}U+{}_0^1n\rightarrow{}_{56}^{144}Ba+{}_{36}^{89}Kr+3{}_0^1n$

45. P.D. across 800Ω resistors = 5.6 V

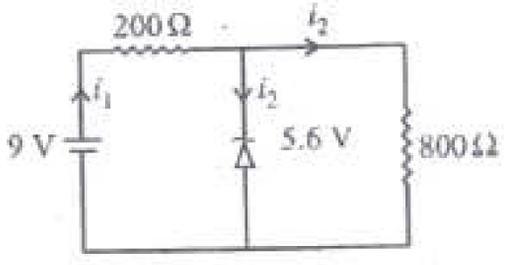
So, $I_{800\Omega}=\frac{5.6}{800}A=7\,mA$

Now, P.D. across

200Ω resistors

$=9-5.6\,V=3.4V$

So, $I_{200\Omega}=\frac{9-5.6}{200}=17\,mA$

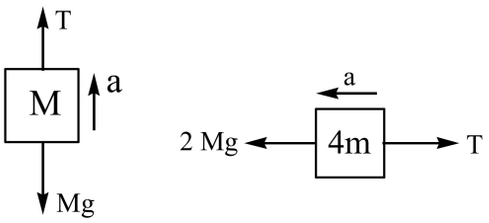


So, current through zener diode $=I_2=17-7=10\,mA$

46. For 4m

$2Mg-T=4Ma\quad ...(i)$

For M



T-mg=Ma

Adding (i) & (ii), we get ….(ii)

$Mg=5Ma \Rightarrow a=\frac{g}{5}$

So, $T=Ma+Mg=\frac{Mg}{5}+Mg=\frac{6}{5}Mg$

47. Given, Height of cylinder, h=20 cm Acceleration due to gravity, $g=10ms^{-2}$

Velocity of efflux $v=\sqrt{2gh}$

Where h is the height of the free surface of liquid from the hole

$v \quad \sqrt{\qquad \times 20} \quad 20m/s$

48. Magnetic field $F=i\ell B \quad (\because \varepsilon = iR)$

$$=\left(\frac{\varepsilon}{R}\right)\ell B=\left(\frac{vB}{R}\right)\ell B=\frac{vB^2\ell^2}{R}=\frac{4}{5}\times\left(\frac{15}{100}\right)^2\times 1^2$$

$$=\frac{4}{5}\times\frac{225}{10^4}=18\times10^{-3}N \qquad (\because \varepsilon = vB\ell)$$

49. Intensity at a point is given by

$$I=I_0\cos^2\left(\frac{\Delta\phi}{2}\right)$$

$\Rightarrow$ According to question $\frac{I_0}{4}=\cos^2\left(\frac{\Delta\phi}{2}\right)$

$$\Delta\phi=\frac{2\pi}{3}\therefore\Delta\phi=\frac{2\pi}{\lambda}\left(\frac{yd}{D}\right)=\frac{2\pi}{3}$$

$$\Rightarrow y=\frac{\lambda D}{3d}=\frac{600\times10^{-9}\times1}{3\times10^{-3}}=2\times10^{-4}m$$

50. Longest wavelength corresponds to transition between n = 3 and n = 4

$$\frac{1}{\lambda}=RZ^2\left(\frac{1}{3^2}-\frac{1}{4^2}\right)=RZ^2\left(\frac{1}{9}-\frac{1}{16}\right)=\frac{7RZ^2}{9\times16}$$

$$\Rightarrow\lambda=\frac{144}{7R}=\frac{\alpha}{7R}(\text{given})\text{ for Z=1} \quad \therefore\alpha=144$$

CHEMISTRY

51. The first electron gain enthalpy is exothermic (or negative). Generally, electron gain enthalpy becomes less exothermic (or less negative) when comparing elements of a group from top to bottom .
There fore, electron gain enthalpy of S> Se and Li>Na .
But there are some exceptions to this .
One of them is the case of a group 17 elements where electron gain is most negative for C1 instead of F, due to extra small size of fluorine
∴ Upon an electron gain, energy releases in the order :
Cl >F, S> Se and Li > Na .
52. Structure I is Trigonal Planar, Structure II, III & IV are pyramidal
53. MnO_2 is not reduced, rather oxidized to $KMnO_4$ during the preparation reaction
54. Conceptual
55. 3° Carbocation is more stable then 2° or 1° Carbocations
56. In Aryl halides Chlorine has resonating structures with benzene ring makes double bond character. Thus makes it a weak leaving group
57. Formaldehyde doesn't have alpha hydrogen.
58. A gives +ve Iodoform test with lower molecular mass.
59. Conceptual
60. Acetic Acid contains alpha hydrogen for halogenations
61. Sucrose is a non reducing sugar. Glucose and Fructose makes a acetal bond with glycosidic linkage.
62. Conceptual
63. $w = -nRT.2.303 \log \frac{v2}{v_1}$
64. $K_2 = \frac{1}{\sqrt{K_1}}$
65. $K_{sp} = s^2$
66. Conceptual
67. $P_s = P^0 \times 2$
68. The correct order for Ionisation Energy is O > S > Se > Te > Po
69. I & II are exhibiting Cis and Trans geometrical Isomers
70. Conceptual
71. Except for O_3 , SCl_2 rest all are linear molecules.
72. I, V, Vi, VII are O,P Directing groups while others are meta directing
73. $\Delta H_{solution}$ =Lattice energy + Hydration energy
74. No.of equation acid= no.of equation base
75. $t_{\frac{1}{2}} = \frac{a_0}{2k}$