JEE Mains (12th)

Sample Paper - IV

DURATION : 180 Minutes **M. MARKS : 300**

General Instructions:

1. Immediately fill in the particulars on this page of the test booklet.
2. The test is of **3 hours** duration.
3. The test booklet consists of **90** questions **(75 to attempt)**. The maximum marks are **300**.
4. There are three subjects in the question paper, Subject I, II and III consisting of Section-I (**Physics),** Section-II **(Chemistry)**, Section-III **(Mathematics)**, and having **30 questions** in each part.
5. There will be a total of **20 MCQs** and **10 Numerical** Value Based Questions **(attempt any 5)**.
6. Each correct answer will give 4 marks while 1 Marks will be deducted for a wrong response.
7. No student is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
8. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.
9. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

Name of the Student (In CAPITALS): _____

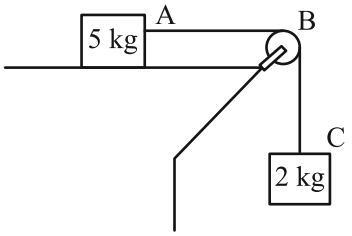
Roll Number: _____

Candidate's Signature: _____

Section-I (PHYSICS)

Section-A

1. A trolley of mass 5 kg on a horizontal smooth surface is pulled by a load of mass 2 kg by means of uniform rope *ABC* of length 2*m* and mass 1 kg. As the load falls from *BC* = 0 to *BC* = 2*m*. its acceleration in m/s^2 changes–



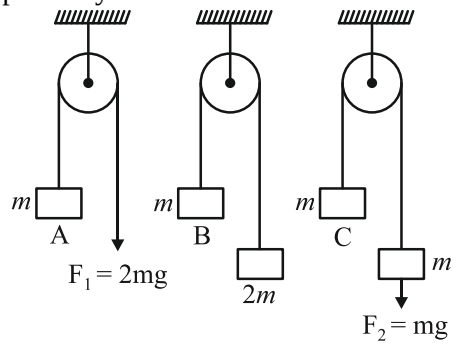
(1) $\frac{20}{6}$ to $\frac{20}{5}$

(2) $\frac{20}{8}$ to $\frac{30}{8}$

(3) $\frac{20}{5}$ to $\frac{30}{6}$

(4) None of these

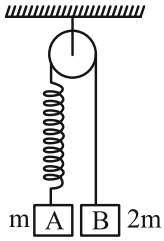
2. In the figure, the blocks *A*, *B* and *C* of mass m, each have accelerations a_1, a_2 and a_3 respectively. F_1 and F_2 are external forces of magnitudes 2mg and mg respectively.



(1) $a_1 = a_2 = a_3$ (2) $a_1 > a_3 > a_2$

(3) $a_1 = a_2, a_2 > a_3$ (4) $a_1 = a_2, a_2 > a_3$

3. Two blocks *A* and *B* of masses *m* & 2*m* respectively are held at rest such that the spring is in natural length. What is the acceleration of both the blocks just after release?



(1) $g\downarrow, g\downarrow$ (2) $\frac{g}{3}\downarrow, \frac{g}{3}\uparrow$

(3) 0, 0 (4) $g\downarrow$, 0

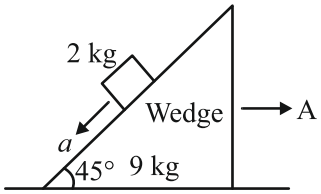
4. An electric dipole of moment $\vec{p} = (-\hat{i} - 3\hat{j} + 2\hat{k}) \times 10^{-29} C$. *m* is a the origin (0, 0, 0). The electric field due to this dipole at $\vec{r} = +\hat{i} + 3\hat{j} + 5\hat{k}$

(note that $\vec{r} \cdot \vec{p} = 0$) is parallel to

(1) $(-\hat{i} - 3\hat{j} + 2\hat{k})$ (2) $(+\hat{i} - 3\hat{j} - 2\hat{k})$

(3) $(-\hat{i} + 3\hat{j} - 2\hat{k})$ (4) $(+\hat{i} + 3\hat{j} - 2\hat{k})$

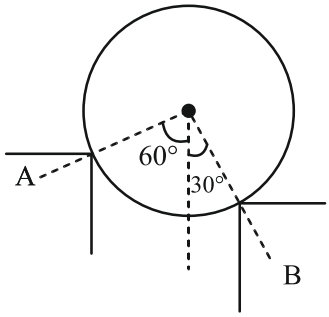
5. A block of mass 2 kg slides down the face of a smooth 45° wedge of mass 9 kg as shown in figure. The wedge is placed on a frictionless horizontal surface. Determine the acceleration of the wedge.



(1) 2 m/s^2 (2) $\frac{11}{\sqrt{2}}$ m/s^2

(3) 1 m/s^2 (4) none of these

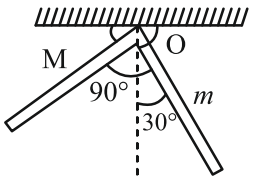
6. A cylinder of mass *M* and radius *R* is resting on two corner edges *A* and *B* as shown in figure. The normal reaction at the edges *A* and *B* are: (Neglect friction)



(1) $N_A = \sqrt{2} N_B$ (2) $N_A = \sqrt{3} N_B$

(3) $N_A = \frac{mg}{2}$ (4) $N_B = \frac{2\sqrt{3}mg}{5}$

7. Two uniform rods of equal length but different masses are rigidly joined to form an L-shaped body, which is then pivoted about *O* as shown in the figure. If in equilibrium the body is in the shown configuration, ratio of *M*/*m* will be:



(1) 2 (2) 3

(3) $\sqrt{2}$ (4) $\sqrt{3}$

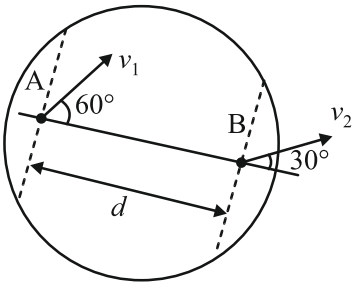
8. Two points *A* & *B* on a disc have velocities v_1 and v_2 at some moment. Their directions make angles 60° and 30° respectively with the line of separation as shown in figure. The angular velocity of disc is:

(1) $\frac{\sqrt{3}v_1}{d}$

(2) $\frac{v_2}{\sqrt{3}d}$

(3) $\frac{v_2 - v_1}{d}$

(4) $\frac{v_2}{d}$



9. A point dipole $\vec{p} = -p_0\hat{x}$ is kept at the origin. The potential and electric field due to this dipole on the *y*-axis at a distance *d* are, respectively:
(Take $V = 0$ at inifinity)

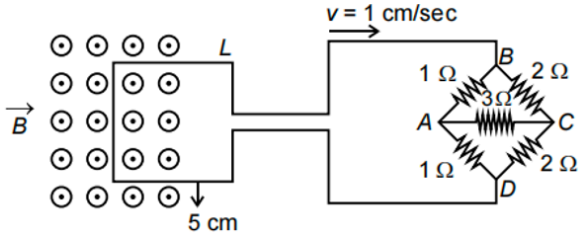
(1) $\frac{|\vec{p}|}{4\pi\varepsilon_0 d^2}, \frac{\vec{p}}{4\pi\varepsilon_0 d^3}$

(2) $\frac{|\vec{p}|}{4\pi\varepsilon_0 d^2}, \frac{-\vec{p}}{4\pi\varepsilon_0 d^3}$

(3) $0, \frac{-\vec{p}}{4\pi\varepsilon_0 d^3}$

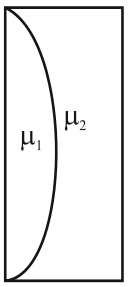
(4) $0, \frac{\vec{p}}{4\pi\varepsilon_0 d^3}$

10. The figure shows a square loop *L* of side 5 cm which is connected to a network of resistances. The whole setup is moving towards right with a constant speed of 1 cm s^{-1}. At some instant, a part of *L* is in a uniform magnetic field of 1 T, perpendicular to the plane of the loop. If the resistance of *L* is 1.7Ω, the current in the loop at that instant will be close to:



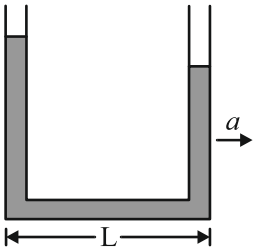
(1) 1 μA (2) 60 μA
(3) 150 μA (4) 115 μA

11. Curved surfaces of a plano-convex lens of refractive index μ_1 and a plano-concave lens of refractive index μ_2 have equal radius of curvature as shown in figure. Find the ratio of radius of curvature to the focal length of the combined lenses.



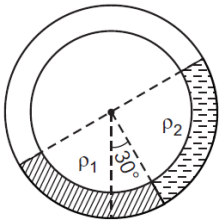
(1) $\mu_2 - \mu_1$ (2) $\mu_1 - \mu_2$
(3) $\frac{1}{\mu_2 - \mu_1}$ (4) $\frac{1}{\mu_1 - \mu_2}$

12. A liquid stands at the plane level in the U-tube when at rest. If areas of cross-section of both the limbs are equal, what will be the difference in heights *h* of the liquid in the two limbs of U-tube, when the system is given an acceleration *a* in horizontal direction towards right as shown?



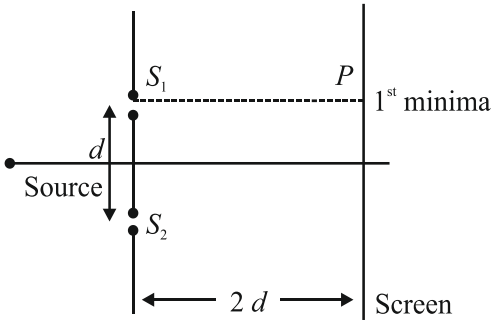
(1) $\frac{Lg}{a}$ (2) $\frac{La}{g}$
(3) $\frac{Lg^2}{a^2}$ (4) zero

13. A thin uniform circular tube is kept in a vertical plane. Equal volumes of two immiscible liquids whose densities are ρ_1 and ρ_2 fill half of the tube as shown. In equilibrium the radius passing through the interface makes an angle of 30° with vertical. The ratio of densities (ρ_1/ρ_2) is equal to



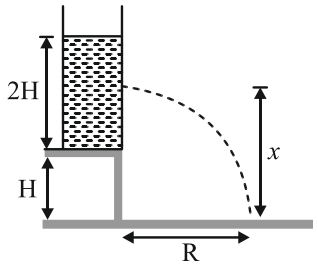
(1) $\frac{\sqrt{3}-1}{2-\sqrt{3}}$
(2) $\frac{\sqrt{3}+1}{2+\sqrt{3}}$
(3) $\frac{\sqrt{3}-1}{\sqrt{3}+1}$
(4) $\frac{\sqrt{3}+1}{\sqrt{3}-1}$

14. Consider a Young's double slit experiment as shown in figure. What should be the slit separation *d* in terms wavelength λ such that the first minima occurs directly in front of the slit (S_1)?



(1) $\frac{\lambda}{2(\sqrt{5}-2)}$ (2) $\frac{\lambda}{2(5-\sqrt{2})}$
(3) $\frac{\lambda}{(5-\sqrt{2})}$ (4) $\frac{\lambda}{(\sqrt{5}-2)}$

15. A tank is filled up to a height 2*H* with a liquid and is placed on a platform of height *H* from the ground. The distance *x* from the ground where a small hole is punched to get the maximum range *R* is



(1) H (2) $1.25\,H$
(3) $1.5\,H$ (4) $2\,H$

16. Heat flows radially outward through a spherical shell of outside radius R_2 and inner radius R_1. The temperature of inner surface of shell is θ_1 and that of outer is θ_2. The radial distance from centre of shell where the temperature is just half way between θ_1 and θ_2 is:

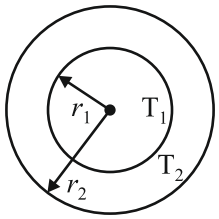
(1) $\dfrac{R_1+R_2}{2}$

(2) $\dfrac{R_1R_2}{R_1+R_2}$

(3) $\dfrac{2R_1R_2}{R_1+R_2}$

(4) $R_1+\dfrac{R_2}{2}$

17. The figure shows a system of two concentric spheres of radii r_1 and r_2 and kept at temperature T_1 and T_2, respectively. The radial rate of flow of heat in a substance between the two concentric spheres is proportional to:



(1) $\dfrac{(r_2-r_1)}{(r_1r_2)}$ (2) $\ln\dfrac{(r_2)}{(r_1)}$

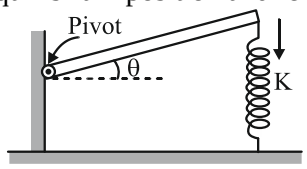
(3) $\dfrac{r_1r_2}{(r_2-r_1)}$ (4) (r_2-r_1)

18. Two particles *P* and *Q* describe S.H.M. of same amplitude a, same frequency f along the same straight line from the same mean position. The maximum distance between the two particles is $a\sqrt{2}$. The initial phase difference between the particle is:

(1) zero (2) $\dfrac{\pi}{2}$

(3) $\dfrac{\pi}{6}$ (4) $\dfrac{\pi}{3}$

19. A horizontal rod of mass m and length *L* is pivoted at one end. The other end of rod is supported by a spring of force constant *k* as shown in figure. The rod is displaced by a small angle θ from its horizontal equilibrium position and released.



The angular frequency of the subsequent simple harmonic motion is:

(1) $\sqrt{\dfrac{3k}{m}}$ (2) $\sqrt{\dfrac{k}{3m}}$

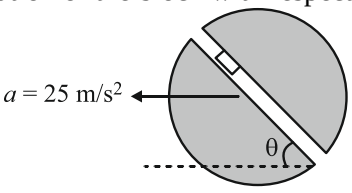
(3) $\sqrt{\dfrac{3k}{m}+\dfrac{3g}{2L}}$ (4) $\sqrt{\dfrac{k}{m}}$

20. Two coherent source of light interface. The intensity ratio of two source is 1 : 4. For this interference pattern if the value of $\dfrac{I_{max}+I_{min}}{I_{max}-I_{min}}$ is equal to $\dfrac{2\alpha+1}{\beta+3}$, then $\dfrac{\alpha}{\beta}$ will be

(1) 1.5 (2) 2
(3) 0.5 (4) 1

Section-B

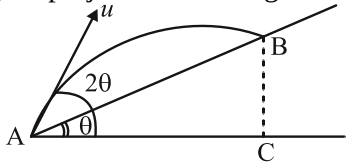
21. A circular disc with a groove along its diameter is placed horizontally. A block of mass 1 kg is placed as shown. The coefficient of friction between the block and all surface of groove in contact is $\mu = \dfrac{2}{5}$. The disc has an acceleration of 25 m/s^2. Find the acceleration of the block with respect to disc.



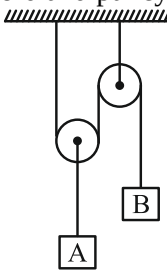
cos θ = 4/5
sin θ = 3/5

22. Two electric dipoles of dipole moments 1.2×10^{-30} C-m and 2.4×10^{-30} C-m are placed in two different uniform electric fields of strength 5×10^4 NC^{-1} and 15×10^4 NC^{-1} respectively. Then ratio of maximum torque experienced by the electric dipoles will be $\dfrac{1}{x}$. The value of *x* is _____.

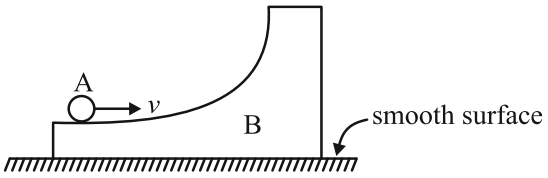
23. A particle is projected from A on plane *AB*, so that $AB = \dfrac{2u^2\tan\theta}{g\sqrt{3}}$ in the figure as shown. If *u* is the velocity of projection, find angle θ _____.



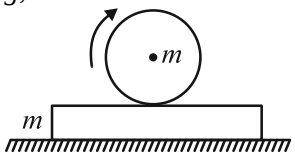
24. Block A has a weight of 300 *N* and block *B* has weight 50*N*. Calculate the distance *A* must descend from rest before it obtains a speed of 4 m/s (Neglect the mass of cord and pulleys). (Take $g = 10\ m/s^2$)



25. In the figure shown a ring *A* is rolling without sliding with a velocity v on the horizontal surface of the body *B* (of same mass as *A*). All surfaces are smooth. *B* has no initial velocity. If maximum height from initial position reached by *A* on *B* is $\frac{v^2}{Ng}$, then *N* _____ is (from initial position)



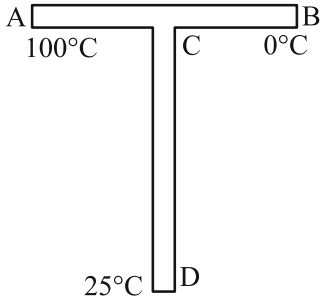
26. A uniform sphere of mass '*m*' is given some angular velocity about a horizontal axis through its centre and gently placed on a plank of mass '*m*'. The co-efficient of friction between the two is μ. If the plank rests on a smooth horizontal surface. The initial acceleration of the centre of sphere relative to the plank *Nmg*, then find the value of *N*



27. A particle of mass *m* moves in a circular orbit in a central potential field $U(r) = U_0 r^4$. If Bohr's quantization conditions are applied, radii of possible orbitals r_n vary with $n^{\frac{1}{\alpha}}$, where α is _____.

28. Sodium light of wavelengths 650 nm and 655 nm is used to study diffraction at a single slit of aperture 0.5 mm. The distance between the slit and the screen is 2.0 m. The separation between the positions of the first maxima of diffraction pattern obtained in the two cases is _____ $\times 10^{-5}$ m.

29. A rod *CD* of thermal resistance 5.0 K/W is joined at the middle of an identical rod AB as shown in figure. The ends *A*, *B* and *D* are maintained at 100ºC, 0ºC and 25ºC respectively. Find the heat current in *CD*



30. A deuteron and a proton moving with equal kinetic energy enter into a uniform magnetic field at right angle to the field. If r_d and r_p are the radii of their circular paths respectively, the ratio $\frac{r_d}{r_p}$ will be $\sqrt{x}:1$ where *x* is _____.

Section-II (CHEMISTRY)

Section - A

31. If the uncertainty of the position of an electron is zero, the uncertainty of its momentum would be:
(1) Zero
(2) $\geq \frac{h}{4\pi}$
(3) $< \frac{h}{4\pi}$
(4) Infinite

32. In the chromate ion, CrO_4^{2-}
(1) (Cr–O) bonds are all non-equivalent
(2) All four (Cr–O) bonds are all equivalent
(3) two (Cr–O) bonds are equivalent and the remaining two are equivalent but different from the other two
(4) Three (Cr–O) bonds are equivalent and the rest (Cr–O) bond is non-equivalent

33. Shape of NH_3 is very similar to that of:
(1) BH_3 (2) CH_3^-
(3) CH_3^+ (4) SO_4^{2-}

34. Which of the following compounds was prepared by Henri Becquerel?
(1) $K_2UO_2(SO_4)_2.2H_2O$
(2) $RaSO_4$
(3) U_3O_8
(4) ThO_2

35. For one mole of an ideal gas, $R = \frac{PV}{T}$. The value of R varies with:
(1) P
(2) V
(3) T
(4) none of these

36. The osmotic pressure of a solution increases if the:
(1) number of solute molecules is increased
(2) temperature is decreased
(3) volume is increased
(4) value of R is increased

37. Consider the equilibrium

$$CO_2(g) \rightleftharpoons CO(g) + \frac{1}{2}O_2(g)$$

The equilibrium constant K is given by (when $\alpha << 1$)

(1) $K = \frac{\alpha^{3/2}}{\sqrt{2}}$ (2) $K = \frac{\alpha^3}{2}$

(3) $K = \frac{\alpha^{3/2}}{2}$ (4) $K = \frac{\alpha^{3/2}}{\sqrt{3}}$

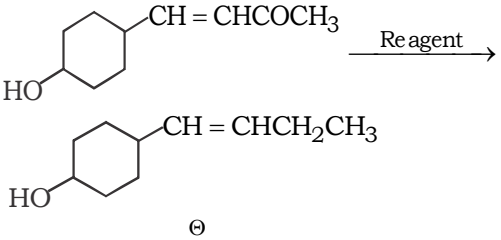
38. When HCl gas is passed through saturated solution of common salt, pure NaCl is precipitated because:
(1) HCl is highly ionized in the solution
(2) HCl is highly soluble in water
(3) the solubility product of NaCl is lowered by HCl
(4) the ionic product $[Na^+][Cl^-]$ exceeds the solubility product of NaCl

39. 1 F of charge will produce 1 gram-atom of metal from a solution of:
(1) $ZnSO_4$ (2) $CaCl_2$
(3) NaCl (4) $Al_2(SO_4)_3$

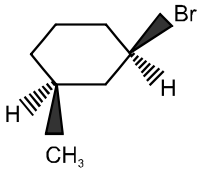
40. Which of the following on thermal decomposition yields a basic as well as an acidic oxide?
(1) $NaNO_3$
(2) $KClO_3$
(3) $CaCO_3$
(4) NH_4NO_3

41. Very pure hydrogen (99.9%) can be made by which of the following processes?
(1) Reaction of methane with steam
(2) Mixing natural hydrocarbons of high molecular weight
(3) Electrolysis of water
(4) Reaction of salt like hydrides with water

42. In the given transformation, which of the following is the most appropriate reagent?



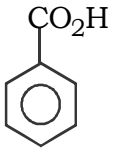
(1) $NH_2NH_2, \overset{\ominus}{O}H$
(2) Zn–Hg/HCl
(3) Na, Liq. NH_3
(4) $NaBH_4$

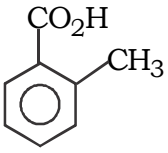
43. 

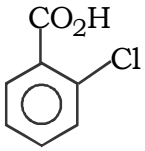
+ KOH $\xrightarrow{\text{acetone}}$ Product

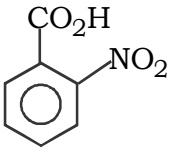
(1R, 3S)–Cis–1–Bromo–3–methylcyclohexane.
The product formed in the reaction is
(1) (1R, 3S)–Cis–3–methyl cyclohexanol
(2) (1S, 3S)–Cis–3– methyl cyclohexanol
(3) (1S, 3S)–Trans–3–methyl cyclohexanol
(4) (1R, 3R)–Trans–3–methyl cyclohexanol

44. Which compound is least acidic:

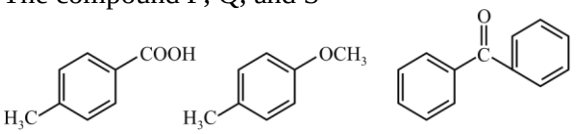
(1) 

(2) 

(3) 

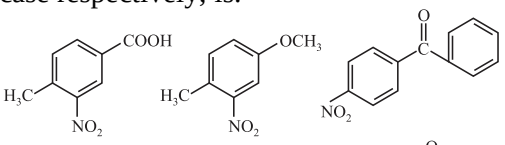
(4) 

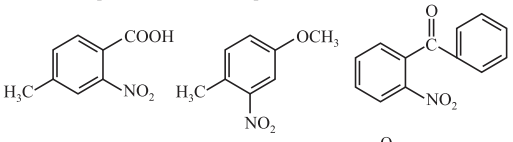
45. The compound P, Q, and S

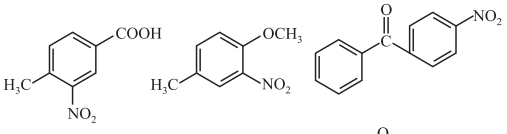


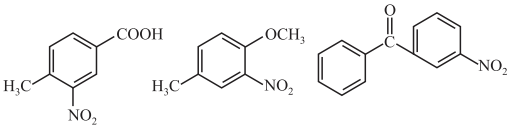
P Q S

Where separately subjected to nitration using $\frac{HNO_3}{H_2SO_4}$ mixture. The major product formed in each case respectively, is:

(1) 

(2) 

(3) 

(4) 

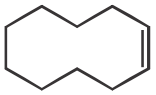
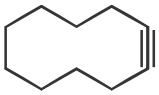
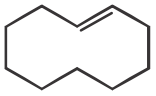
46. Which one of the following has an optical isomer?
(1) $[Zn(en)(NH_3)_2]^{2+}$
(2) $[Co(en)_3]^{3+}$
(3) $[Co(H_2O)_4(en)]^{3+}$
(4) $[Zn(en)_2]^{2+}$
(en=ethylenediamine)

47. Which one of the following will have the lowest molar conductivity value?
(1) $[Co(NH_3)_6]Cl_3$
(2) $[Co(NH_3)_5]Cl_2$
(3) $[Co(NH_3)_3Cl_3]$
(4) $[Co(NH_3)_4Cl_2]Cl$

48. Which of the following shape are not possible for possible value of 'n' in XeFn molecule?
(1) Linear
(2) Square planar
(3) Trigonal planar
(4) Capped octahedral

49. $HC \equiv CH \xrightarrow[Cl-(CH_2)_8-Cl]{KNH_2} A \xrightarrow[Pd-CaCO_3]{H_2} B \xrightarrow{Br_2/CCl_4} C \xrightarrow[2mole]{KNH_2} D \xrightarrow{Na,\ NH_3(l)} E$

E is:

(1) 
(2) 
(3) 
(4) None of these

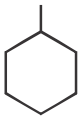
50. Tautomerism is exhibited by:
(1) $(CH_3)_3CNO$
(2) $(CH_3)_2NH$
(3) R_3CNO_2
(4) RCH_2NO_2

Section - B

51. A Simplified application of MO theory to the hypothetical molecule OF would give its bond order as (multiply the answer by 10):

52. A certain gas effuses through a small opening of a vessel at a rate which is exactly one-fifth the rate at which helium does the same. Thus, the molecular weight of the gas is:

53. Total isomeric products obtained on complete ozonolysis of racemic mixture of 3,4,6-Trimethyl octa-2,4-diene.

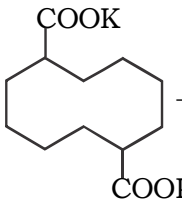
54. $X \xrightarrow{Zn-Hg/HCl}$ 

Total isomeric reactants (X) that will give the above product

55. The maximum amount of $BaSO_4$ that would be precipitated on mixing 1 litre $BaCl_2$ (0.5M) with 1 litre H_2SO_4(1M) is (multiply the answer by 100):

56. $Cr(s) \mid Cr^{3+} \parallel Fe^{2+} \mid Fe(s)$. In the above cell; the value of 'n' in Nernst equation, i.e., $E = E^o - \frac{0.059}{n}\log_{10}Q$ will be

57. For a liquid, enthalpy of fusion is 1.435 kcal mol^{-1} and molar entropy change is 5.26 cal mol^{-1} K^{-1}. The freezing point of liquid in Kelvin will be

58. 

$\xrightarrow{Kolbe's\ electrolysis}$ Product

How many secondary carbons are present in the product.

59. Number of carbon atom in compound D is

$$Acetaldehyde \xrightarrow[[O]]{K_2Cr_2O_7} A \xrightarrow{Ca(OH)_2} B \xrightarrow{distillation} C \xrightarrow{dil\ OH^-} D$$

60. Aqueous solution of Ni^{+2} contains $[Ni(H_2O)_6]^{2+}$ and its magnetic moment is 2.83 BM. When ammonia is added in it, then number of unpaired electrons in metal ion in solution becomes.

Section-III (MATHEMATICS)

Section - A

61. Let $f(x)$ be differentiable function defined on [0, 2] such that $f'(x) = f'(2 - x)$ for all $x \in (0,2)$, $f(0) = 1$ and $f(2) = e^2$. Then the value of $\int_0^2 f(x)\,dx$ is
(1) $2(1 + e^2)$
(2) $1 - e^2$
(3) $1 + e^2$
(4) $2(1 - e^2)$

62. The value of integral $\int_1^3 \left[x^2 - 2x - 2\right] dx$, where $[x]$ denotes the greatest integer less than or equal to x, is
(1) $-\sqrt{2} - \sqrt{3} - 1$ (2) $-\sqrt{2} - \sqrt{3} + 1$
(3) -5 (4) -4

63. For the system of linear equation:
$x - 2y = 1$, $x - y + kz = -2$, $ky + 4z = 6$, $k \in R$,
Consider the following statements:
(a) The system has unique solution if $k \neq 2, k \neq -2$.
(b) The system has unique solution if $k = -2$.
(c) The system has unique solution if $k = 2$.
(d) The system has no solution if $k = 2$.
(e) The system has infinite number of solutions if $k \neq -2$.
Which of the following statements are correct?
(1) (b) and (e) only
(2) (c) and (4) only
(3) (a) and (e) only
(4) (a) and (d) only

64. Let $a, b, \in R$. If the mirror image of the point $P(a, 6, 9)$ with respect to the line $\frac{x-3}{7}=\frac{y-2}{5}=\frac{z-1}{-9}$ is $(20, b, -a-9)$, then $|a+b|$ is equal to:

(1) 90 (2) 86

(3) 84 (4) 88

65. Let a, b, c be in arithmetic progression. Let the centroid of the triangle with vertices (a, c), $(2, b)$ and (a, b) be $\left(\frac{10}{3},\frac{7}{3}\right)$ If α,β are the roots the equation $ax^2 + bx + 1 = 0$, then the value of $\alpha^2+\beta^2-\alpha\beta$ is:

(1) $-\frac{69}{256}$ (2) $\frac{69}{256}$

(3) $\frac{27}{256}$ (4) $-\frac{71}{256}$

66. Let $f: R \to R$ be defined as

$$f(x)=\begin{cases} -55x & \text{If } x<-5 \\ 2x^3-3x^2-120x, & \text{If } -5\le x\le 4 \\ 2x^3-3x^2-36x-336, & \text{If } x>4, \end{cases}$$

Let $A = \{x \in R$ is increasing$\}$. Then A is equal to

(1) $(-5,-4)\cup(4,\infty)$

(2) $(-\infty,-5)\cup(4,\infty)$

(3) $(-\infty,-5)\cup(-4,\infty)$

(4) $(-5,\infty)$

67. The probability that two randomly selected subsets of the set $\{1, 2, 3, 4, 5\}$ have exactly two elements in their intersection is:

(1) $\frac{65}{2^7}$ (2) $\frac{35}{2^7}$

(3) $\frac{135}{2^9}$ (4) $\frac{65}{2^8}$

68. The area of the region:

$R=\{(x,y):5x^2\le y\le 2x^2+9\}$ is

(1) $9\sqrt{3}$ square unit (2) $12\sqrt{3}$ square units

(3) $6\sqrt{3}$ square unit (4) $11\sqrt{3}$ square units

69. Let A and B are 3×3 real matrices such that A is symmetric matrix and B is skew-symmetric matrix. Then the system of linear equations $(A^2B^2 - B^2A^2)$ $X = O$, where X is a 3×1 column matrix of unknown variables and O is a 3×1 null matrix has:

(1) a unique solution

(2) infinitely many solutions

(3) exactly two solutions

(4) No solution

70. For which of the following curves, the line $x+\sqrt{3}y=2\sqrt{3}$ is the tangent at the point $\left(\frac{3\sqrt{3}}{2},\frac{1}{2}\right)$?

(1) $2x^2-18y^2=9$ (2) $y^2=\frac{1}{6\sqrt{3}}x$

(3) $x^2+y^2=7$ (4) $x^2+9y^2=9$

71. If $n \ge 2$ is a positive integer, then the sum of the series ${}^{n+1}C_2+2\left({}^2C_2+{}^3C_2+{}^4C_2+\ldots.+{}^nC_2\right)$ is

(1) $\frac{n(n+1)^2(n+2)}{12}$ (2) $\frac{n(n+1)(2n+1)}{6}$

(3) $\frac{n(n-1)(2n+1)}{6}$ (4) $\frac{n(2n+1)(3n+1)}{6}$

72. The vector equation of the plane passing through the intersection of the planes $\vec{r}.\left(\hat{i}+j+k\right)=1$ and $\vec{r}.\left(\hat{i}-2j\right)=-2$, and the point (1, 0, 2) is:

(1) $\vec{r}.\left(\hat{i}+7j+3k\right)=\frac{7}{3}$

(2) $\vec{r}.\left(3\hat{i}+7j+3k\right)=7$

(3) $\vec{r}.\left(\hat{i}-7j+3k\right)=\frac{7}{3}$

(4) $\vec{r}.\left(\hat{i}+7j+3k\right)=7$

73. The negation of the statement $\sim p \wedge (p \vee q)$

(1) $\sim p \vee q$ (2) $p \wedge \sim q$

(3) $p \vee \sim q$ (4) $\sim p \wedge q$

74. Let f be a twice differentiable funciton defined on R such that $f(0) = 1$, $f'(0) = 2$ and $f(x) \ne 0$ for all $x \in R$. If $\begin{vmatrix} f(x) & f'(x) \\ f'(x) & f''(x) \end{vmatrix}=0$, for all $x \in R$, then the value of $f(1)$ lies in the interval.

(1) (3, 6) (2) (6, 9)

(3) (0, 3) (4) (9, 12)

75. If P is a point on the parabola $y = x^2 + 4$ which is closest to the straight line $y = 4x - 1$, then the co-ordination of P are:

(1) (2, 8) (2) (3, 13)

(3) (1, 5) (4) (–2, 8)

76. A possible value of $\tan\left(\frac{1}{4}\sin^{-1}\frac{\sqrt{63}}{8}\right)$ is:

(1) $\frac{1}{\sqrt{7}}$ (2) $2\sqrt{2}-1$

(3) $\frac{1}{2\sqrt{2}}$ (4) $\sqrt{7}-1$

77. The line $2x - y + 1 = 0$ is a tangent to the circle at the point (2, 5) and the centre of the circle lies on $x - 2y = 4$. Then, the radius of the circle is:

(1) $3\sqrt{5}$

(2) $5\sqrt{3}$

(3) $5\sqrt{4}$

(4) $4\sqrt{5}$

78. If the curve $y = ax^2 + bx + c$, $x \in R$ passes through the point (1, 2) and the tangent line to this curve at origin is $y = x$, then the possible values of a, b, c are:

(1) $a = \frac{1}{2}, b = \frac{1}{2}, c = 1$

(2) $a = -1, b = 1, c = 1$

(3) $a = 1, b = 1, c = 0$

(4) $a = 1, b = 0, c = 1$

79. If the integral $\int_0^{10} \frac{[\sin 2\pi x]}{e^{x-[x]}} dx = \alpha e^{-1} + \beta e^{-\frac{1}{2}} + \gamma$ where α, β, γ are integers and $[x]$ denotes the greatest integer less than or equal to x, then the value of $\alpha + \beta + \gamma$ is equal to

(1) 0

(2) 20

(3) 25

(4) 10

80. If a curve $y = f(x)$ passes through the point (1, 2) and satisfies $x\frac{dy}{dx} + y = bx^4$, then for what value of b, $\int_1^2 f(x)dx = \frac{62}{5}$?

(1) 5 (2) $\frac{62}{5}$

(3) 10 (4) $\frac{31}{5}$

Section - B

81. Let λ be an integer. If the shortest distance between the lines $x - \lambda = 2y - 1 = -2z$ and $x = y + 2\lambda = z - \lambda$ is $\frac{\sqrt{7}}{2\sqrt{2}}$, then the value of $|\lambda|$ is ……

82. Let $f : \mathbb{R} \to \mathbb{R}$ be a continuous function such that $f(x) + f(x+1) = 2$, for all $x \in \mathbb{R}$. If $I_1 = \int_0^8 f(x)dx$ and $I_2 = \int_{-1}^3 f(x)dx$, then the value of $I_1 + 2I_2$ is equal to

83. Let $i = \sqrt{-1}$, if $\frac{(-1+i\sqrt{3})^{21}}{(1-i)^{24}} + \frac{(1+i\sqrt{3})^{21}}{(1+i)^{24}} = k$ and $n = [|k|]$ be the greatest integral part of $|k|$. Then $\sum_{j=0}^{n+5} (j+5)^2 - \sum_{j=0}^{n+5} (j+5)$ is equal to ….

84. The number of the real roots of the equation $(x+1)^2 + |x-5| = \frac{27}{4}$ is……

85. Let a point P be such that its distance from the point (5, 0) is thrice the distance of P from the point (–5, 0). If the locus of the point P is a circle of radius r, then $16r^2$ is equal to.

86. The sum of first four terms of a geometric progression (G.P) is $\frac{65}{12}$ and the sum of their respective reciprocals is $\frac{65}{18}$. If the product of first three terms of the G.P is 1, and the third term is α, then 2α is ……

87. The students $S_1, S_2, \ldots\ldots\ldots S_{10}$ are to be divided into 3 groups A, B and C such that each group has at least one student and the group C has at most 3 students. Then the total number of possibilities of forming such groups is.....

88. If $a + \alpha = 1, b + \beta = 2$ and $af(x) + \alpha f\left(\frac{1}{x}\right) = bx + \frac{\beta}{x}, x \neq 0$, then the value of the equation $\frac{f(x) + f\left(\frac{1}{x}\right)}{x + \frac{1}{x}}$ is

89. If the variance of 10 natural numbers 1, 1, 1....1 k less than 10, then the maximum possible value of k is.....

90. Let $ABCD$ be a square of side of unit length.
Let a circle C_1 centered at A with unit radius is drawn. Another circle C_2 which touches C_1 and the lines AD and AB are tangent to it, is also drawn. Let a tangent line from the point C to the circle C_2 meet the side AB at E. If the length of EB is $\alpha + \sqrt{3}\beta$, where α, β are integers, then $\alpha + \beta$ is equal to