JEE Mains (12th)

Sample Paper - I

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. The resultant of two vectors at an angle 150° is 10 units and is perpendicular to one vector. The magnitude of the smaller vector is

(1) 10 units

(2) $10\sqrt{3}$ units

(3) $10\sqrt{2}$ units

(4) $5\sqrt{3}$ units

2. A rifle bullets loses $\left(\frac{1}{20}\right)^{th}$ of its velocity in passing through a plank. Assuming that the plank exerts a constant retarding force, the least number of such planks required just to stop the bullet is

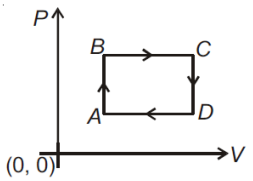
(1) 11

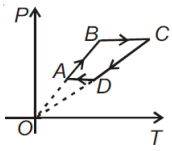
(2) 20

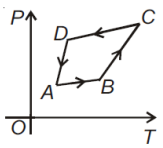
(3) 21

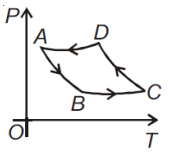
(4) Infinite

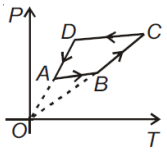
3. The figure shows P-V diagram of a thermodynamic cycle. Which corresponding curve is correct?



(1) 

(2) 

(3) 

(4) 

4. A ball is thrown up vertically with a certain velocity so that, it reaches a maximum height *h*. Find the ratio of the times in which it is at height $\frac{h}{3}$ while going up and coming down respectively

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

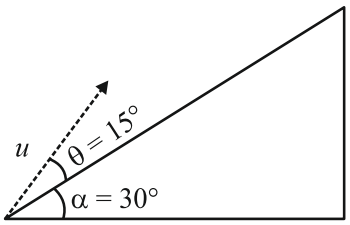
(3) $\frac{\sqrt{3}-1}{\sqrt{3}+1}$ (4) $\frac{1}{3}$

5. By increasing temperature of a gas by 6°C its pressure increases by 0.4 % at constant volume. Then initial temperature of gas is

(1) 1000 K (2) 1500 K

(3) 2000 K (4) 750 K

6. A plane is inclined at an angle $\alpha = 30°$ with respect to the horizontal. A particle is projected with a speed $u = 2\ ms^{-1}$, from the base of the plane, making an angle $\theta = 15°$ with respect to the plane as shown in the figure. The distance from the base, at which the particle hits the plane is close to:
(Take $g = 10\ ms^{-2}$)



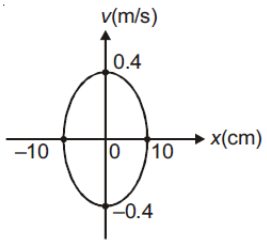
(1) 18 cm

(2) 20 cm

(3) 14 cm

(4) 26 cm

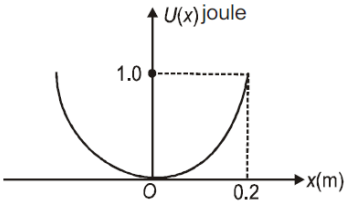
7. The plot of velocity (*v*) versus displacement (*x*) of a particle executing simple harmonic motion is shown in figure. The time period of oscillation of particle is



(1) $\frac{\pi}{2}$ s (2) π s

(3) 2π s (4) 3π s

8. A particle of mass 4 kg moves simple harmonically such that its *PE* (*U*) varies with position *x*, as shown. The period of oscillations is



(1) $\frac{2\pi}{25}$ s (2) $\frac{\pi\sqrt{2}}{5}$ s

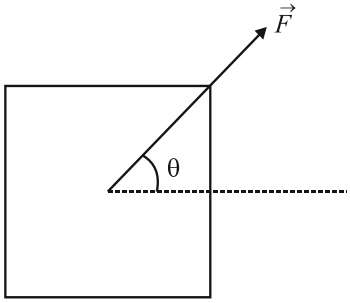
(3) $\frac{4\pi}{5}$ s (4) $\frac{2\pi\sqrt{2}}{5}$ s

9. If the length of a clock pendulum increases by 0.2% due to atmospheric temperature rise, then the loss in time of clock per day is

(1) 86.4 s (2) 43.2 s

(3) 72.5 s (4) 32.5 s

10. A block of mass *m* slides along a floor while a force of magnitude *F* is applied to it at an angle θ as shown in figure. The coefficient of kinetic friction is μ_K. Then, the block's acceleration 'a' is given by: (*g* is acceleration due to gravity)



(1) $\frac{F}{m}\cos\theta+\mu_K\left(g-\frac{F}{m}\sin\theta\right)$

(2) $\frac{F}{m}\cos\theta-\mu_K\left(g-\frac{F}{m}\sin\theta\right)$

(3) $-\frac{F}{m}\cos\theta-\mu_K\left(g-\frac{F}{m}\sin\theta\right)$

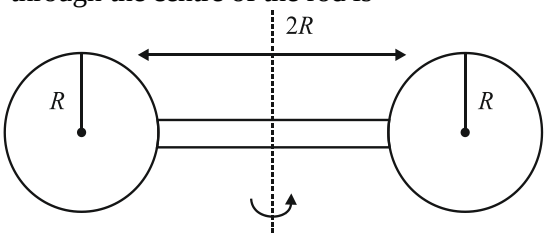
(4) $\frac{F}{m}\cos\theta-\mu_K\left(g+\frac{F}{m}\sin\theta\right)$

11. Two strings of same material are stretched to the same tension. If their radii are in the ratio 1 : 2, then respective wave velocities in them will be in ratio

(1) 4 : 1 (2) 2 : 1

(3) 1 : 2 (4) 1 : 4

12. Two identical spherical balls of mass *M* and radius *R* each are stuck on two ends of a rod of length 2*R* and mass *M* (see figure). The moment of inertia of the system about the axis passing perpendicularly through the centre of the rod is



(1) $\frac{152}{15}MR^2$ (2) $\frac{17}{15}MR^2$

(3) $\frac{209}{15}MR^2$ (4) $\frac{137}{15}MR^2$

13. An electron with kinetic energy K_1 enters between parallel plates of a capacitor at an angle 'a' with the plates. It leaves the plates at angle 'b' with kinetic energy K_2. Then the ratio of kinetic energies $K_1 : K_2$ will be:

(1) $\frac{\cos\beta}{\sin\alpha}$ (2) $\frac{\cos\beta}{\cos\alpha}$

(3) $\frac{\cos^2\beta}{\cos^2\alpha}$ (4) $\frac{\sin^2\beta}{\cos^2\alpha}$

14. In a Young's double slit experiment, the intensity at the central maximum is I_0. The intensity at a distance β/4 from the central maximum is (β is fringe width)

(1) I_0 (2) $\frac{I_0}{2}$

(3) $\frac{I_0}{\sqrt{2}}$ (4) $\frac{I_0}{4}$

15. A parallel beam of monochromatic light of wavelength 5000 Å is incident normally on a single narrow slit of width 0.001 mm. The light is focused by a convex lens on a screen placed on focal plane. The first minimum will be formed for the angle of diffraction equal to

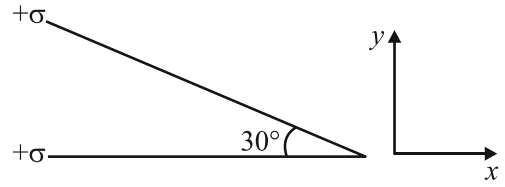
(1) 0°

(2) 15°

(3) 30°

(4) 50°

16. Two infinite planes each with uniform surface charge density +s are kept in such a way that the angle between them is 300. The electric field in the region shown between them is given by



(1) $\frac{\sigma}{2\varepsilon_0}\left[\left(1+\sqrt{3}\right)\hat{y}+\frac{\hat{x}}{2}\right]$

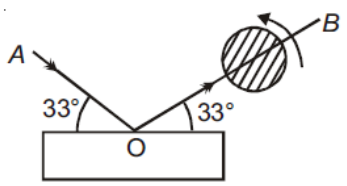
(2) $\frac{\sigma}{2\varepsilon_0}\left[\left(1+\sqrt{3}\right)\hat{y}-\frac{\hat{x}}{2}\right]$

(3) $\frac{\sigma}{2\varepsilon_0}\left[\left(1+\frac{\sqrt{3}}{2}\right)\hat{y}-\frac{\hat{x}}{2}\right]$

(4) $\frac{\sigma}{\varepsilon_0}\left[\left(1+\frac{\sqrt{3}}{2}\right)\hat{y}+\frac{\hat{x}}{2}\right]$

17. A beam of light *AO* is incident on a glass slab (*m* = 1.54) in a direction as shown in the diagram. The reflected ray *OB* is passed through a polariod. On viewing through the polariod, we find that on rotating the polariod

(Given tan 57° = 1.54)



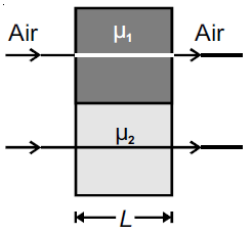
(1) The intensity is reduced down to zero and remains zero

(2) The intensity reduces down some what and rises again

(3) There is no change in intensity

(4) The intensity gradually reduces to zero and then again increases

18. Two light rays initially in same phase travel through two media of equal length L having refractive index μ_1 and μ_2 ($\mu_1 > \mu_2$) as shown in figure. If the wave length of light rays in air is λ, the phase difference of the emerging rays is given by



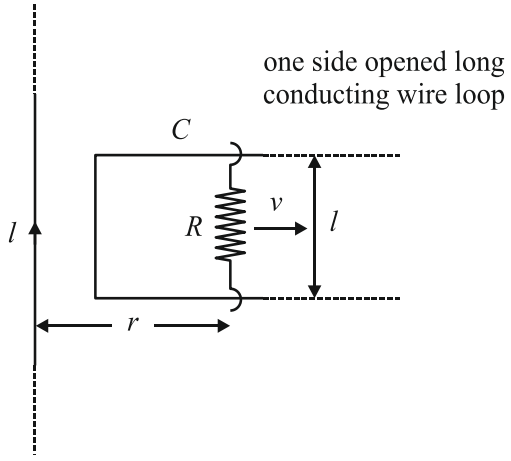
(1) $\frac{L\mu_1}{\lambda\mu_2}$

(2) $\frac{(\mu_1-\mu_2)L}{2\pi\lambda}$

(3) $\frac{2\pi(\mu_1-\mu_2)L}{\lambda}$

(4) Zero

19. An infinitely long, straight wire carrying current I, one side opened rectangular loop and a conductor C with a sliding connector are located in the same plane, as shown, in the figure. The connector has length ℓ and resistance R. It slides to the right with a velocity v. The resistance of the conductor and the self inductance of the loop are negligible. The induced current in the loop, as a function of separation r, between the connector and the straight wire is



(1) $\frac{\mu_0}{4\pi}\frac{lv\ell}{Rr}$

(2) $\frac{\mu_0}{\pi}\frac{lv\ell}{Rr}$

(3) $\frac{\mu_0}{2\pi}\frac{lv\ell}{Rr}$

(4) $\frac{2\mu_0}{\pi}\frac{lv\ell}{Rr}$

20. The region between $y = 0$ and $y = d$ contains a magnetic field $\vec{B} = B\hat{z}$. A particle of mass m and charge q enters the region with a velocity $\vec{v} = v\hat{i}$. If $d = \frac{mv}{2qB}$, the acceleration of the charged particle at the point of its emergence at the other side is

(1) $\frac{qvB}{m}\left(\frac{1}{2}\hat{i} - \frac{\sqrt{3}}{2}\hat{j}\right)$

(2) $-\frac{qvB}{m}\left(\frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j}\right)$

(3) $\frac{qvB}{m}\left(\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)$

(4) $\frac{qvB}{m}\left(\frac{-\hat{j}+\hat{i}}{\sqrt{2}}\right)$

[Section – B]

21. The sound intensity level at a point 4 m from the point source is 10 dB, then the sound level at a distance 2 m from the same source will be

22. The equation of standing wave in a stretched string is given by $y = 5 \sin\left(\frac{\pi x}{3}\right) \cos(40\pi t)$, where x and y are in cm and t in second. The separation between two consecutive nodes is (in cm)

23. A wire of length 314 cm carrying current of 14 A is bent to form a circle. The magnetic moment of the coils is _____ A-m^2. [Given $\pi = 3.14$]

24. A wire of length one metre under a certain initial tension emits a sound of fundamental frequency 256 Hz. When the tension is increased by 1 kg wt, the frequency of the fundamental node increases to 320 Hz. The initial tension in kg-wt is (Give your answer in integer with proper rounding off)

25. In resonance tube two successive positions of resonance are obtained at 15 cm and 48 cm. If the frequency of the fork is 500 cps, the velocity of sound is (in m/sec)

26. A potentiometer wire of length 300 cm is connected in series with a resistance 780 Ω and a standard cell of emf 4 V. A constant current flows through wire. The length of the null point for cell of emf 20 mV is found to be 60 cm. The resistance of the potentiometer wire is _____ Ω.

27. A train moves towards a stationary observer with a speed 34 m/s. The train sounds a whistle and its frequency registered by the observer is f_1. If the speed of the train is reduced to 17 m/s, the frequency registered is f_2. If the speed of sound is 340 m/s then the ratio f_1/f_2 is n/18. Find the value of n.

28. Two slits separated by a distance of 1 mm are illuminated with red light of wavelength 6.5×10^{-7} m. The interference fringes are observed on a screen placed 1 m from the slits. The distance between the third dark fringe and the fifth bright fringe on the same side of central maxima is (in μm)

29. A particle of mass '*m*' is moving in time '*t*' on a trajectory given by

$$r = 10\alpha t^2 \hat{i} + 5\beta(t-5)\hat{j}$$

Where α and β are dimensional constants.
The angular momentum of the particle becomes the same as it was for $t = 0$ at time $t =$ _____ seconds.

30. In YDSE, a thin film ($\mu = 1.6$) of thickness 0.01 mm is introduced in the path of one of the two interfering beams. The central fringe moves to a position occupied by the 10th bright fringe earlier. The wave length of wave is (in nm)

Section-II (CHEMISTRY)

[Section – A]

31. The wave number of a spectral line for a given transition is x cm^{-1} for He^+. Its value for Be^{3+} (iso-electronic species of He^+) for the same transition is:

(1) x cm^{-1} (2) 4x cm^{-1}

(3) $\frac{x}{4}$ cm^{-1} (4) 2x cm^{-1}

32. Match the column:

Column-I	**Column-II**
(1) He	(i) Highest negative electron enthalpy
(2) Cl	(ii) Most electropositive element
(3) Cs	(iii) Strongest reducing agent
(4) Li	(iv) Highest ionisation energy

(1) A-(iii), B-(i), C-(ii), D-(iv)
(2) A-(iv), B-(iii), C-(ii), D-(i)
(3) A-(i), B-(ii), C-(iii), D-(iv)
(4) A-(iv), B-(i), C-(ii), D-(iii)

33. In the aluminothermite process Al acts as :-
(1) Oxidising agent
(2) Flux
(3) Reducing agent
(4) Solder

34. Which of the following carbonates decomposes at lowest temperature:
(1) $MgCO_3$
(2) $CaCO_3$
(3) $SrCO_3$
(4) $BaCO_3$

35. The compound that is both paramagnetic and coloured is:-
(1) $K_2Cr_2O_7$ (2) $(NH_4)_2[TiCl_6]$
(3) $VOSO_4$ (4) $K_3[Cu(CN)_4]$

36. **Statement I:** Decomposition of H_2O_2 can be retarded in the presence of acetanilide.
Statement II: D_2O has greater dielectric constant than H_2O.
(1) Both statement (I) and (II) are true
(2) Both statement (I) and (II) are false
(3) Statement (I) is true but statement (II) is false
(4) Statement (I) is false but statement (II) is true

37. (1) Ozone is colourless gas having characteristics smell
(2) Wet NH_3 is dried by using anhydrous CaO
(3) Cl_2 reacts with cold and dilute NaOH to from sodium chloride and sodium hypochlorite
Select **correct** statements:
(1) (1), (2), (3) (2) Only (1)
(3) Only (2) and (3) (4) Only (3)

38. In which pair, both species have bond order 2.5?
(1) N_2, O_2 (2) NO, O_2^+
(3) CN^-, N_2^+ (4) O_2^-, N_2^-

39. Which of the following is correctly match:–

Compound	**Oxidation number**
(A) AlF_3	(P) +2.5
(B) P_4O_{10}	(Q) +7
(C) $HClO_4$	(R) +5
(D) $S_4O_6^{2-}$	(S) +3

	(A)	**(B)**	**(C)**	**(D)**
(1)	P	Q	R	S
(2)	S	R	Q	P
(3)	S	R	P	Q
(4)	P	Q	S	R

40. X ml of H_2 gas effuses through a hole in a container in 5 seconds. The time taken for the effusion of the same volume of gas specified below under identical condition is :-

(1) 10 seconds, helium

(2) 20 seconds, oxygen

(3) 25 seconds, carbon monoxide

(4) 55 seconds, carbon dioxide

41. The equilibrium constant for the reaction $H_2(g) + S(s) \rightleftharpoons H_2S(g)$; is 18.5 at 925 K and 9.25 at 1000 K respectively. The enthalpy of the reaction will be:

(1) $-68000.05\ J\ mol^{-1}$

(2) $-71080.57\ J\ mol^{-1}$

(3) $-80071.75\ J\ mol^{-1}$

(4) $57080.75\ J\ mol^{-1}$

42. Find out formula of compound having spheres A, B and C. A is present at each element of ccp, B occupies 50% of octahedral voids and C occupies 50% of tetrahedral voids:-

(1) AB_3C

(2) A_2BC_4

(3) AB_4C

(4) A_2BC_2

43. An ideal mixture of liquids A and B with 2 moles of A and 2 moles of B has a total vapour pressure of 1 atm at a certain temperature. Another mixture with 1 mole of A and 3 moles of B has a vapour pressure greater than 1 atm. But if 4 moles of C are added to the second mixture, the vapour pressure comes down to 1 atm. Vapour pressure of C, P_c^0 = 0.8 atm. Calculate the vapour pressures of pure A and pure B:-

(1) $P_A^0 = 1.4$ atm, $P_B^0 = 0.7$ atm

(2) $P_A^0 = 1.2$ atm, $P_B^0 = 0.6$ atm

(3) $P_A^0 = 1.4$ atm, $P_B^0 = 0.6$ atm

(4) $P_A^0 = 0.6$ atm, $P_B^0 = 1.4$ atm

44. Efficiency of the following cell is 84%.

$A(s) + B^{2+}(aq) \rightleftharpoons A^{2+}(aq) + B(s)$; $\Delta H° = -285$ kJ

Then the standard electrode potential of the cell will be:-

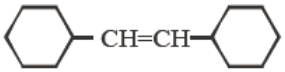
(1) 1.20 V

(2) 2.40 V

(3) 1.10 V

(4) 1.24 V

45. A hydrocarbon $X(C_{14}H_{22})$ on treatment with H_2/Pt gives $C_{14}H_{26}$. Also X on treatment with alkaline $KMnO_4$ followed by hydrolysis of products yields $C_7H_{12}O_2$ which on further heating with soda lime gives cyclohexane. Hence, X is:-

(1) 

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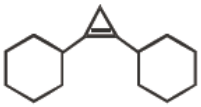
(3) 

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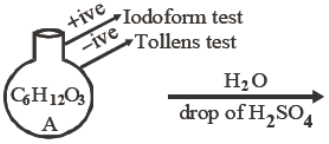
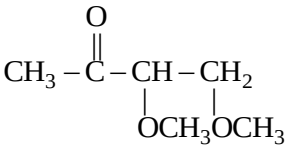
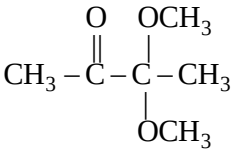
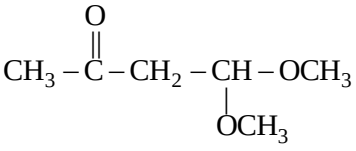
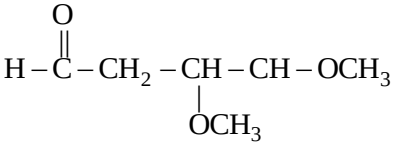
46. 

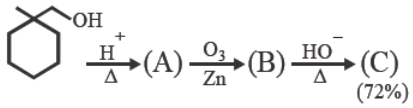
Positive Tollens test Compound (A) is:-

(1) 

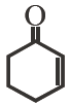
(2) 

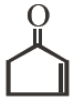
(3) 

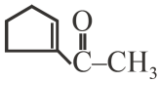
(4) 

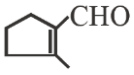
47. 

Product (C) is :-

(1) 

(2) 

(3) 

(4) 

48. The best reaction sequence to convert 2-methyl-1-bromopropane into 4-methyl-2-bromopentane is:

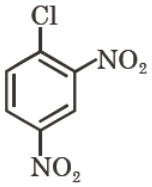
(1) (i) Mg in ether (ii) Acetaldehyde/NH_4Cl
(iii) HBr

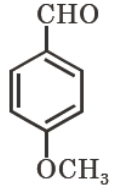
(2) (i) NaC≡CH in ether (ii) $H_3O^+ + HgSO_4$
(iii) HBr, heat

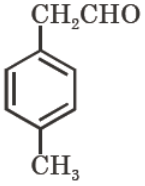
(3) (i) Alcoholic KOH (ii) CH_3COOOH
(iii) H_2/Pt (iv) HBr, heat

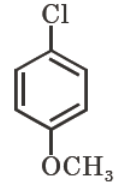
(4) (i) NaC≡CH in ether (ii) H_2, Lindlar catalyst
(iii) HCl , peroxide

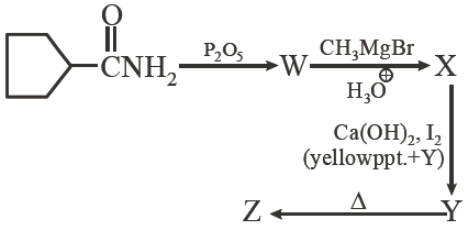
49. The compound(s) that will react(s) with hot concentrated aqueous alkali at atmospheric pressure is/are:-

(1) 

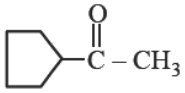
(2) 

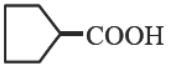
(3) 

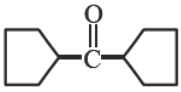
(4) 

50. 

Z is:-

(1) 

(2) 

(3) 

(4) 

[Section – B]

51. How many stereoisomers are possible for $[Co(en)(NH_3)_2Cl_2]^+$?

52. Number of oxygen atoms shared per SiO_4^{4-} tetrahedron in single chain silicates are _____.

53. How many of the following compounds are paramagnetic?
KO_2, H_2O_2, BaO_2, O_3, O_2, $K_3[Co(OX)_3]$

54. Total number of nitrogen atoms in one molecule of melamine are-

55. Count the paramagnetic species among the following: B_2, NO_2, NO, CO, N_2^+, O_2^-, O_2^{2-}, CN^-, O_2^{+2}, O_2, N_2.

56. $XeF_6 + H_2O \longrightarrow X + 2HF$
If number of ionic pair at central atom of X = A and d-orbital used in the hybridization of X = B, find (4A + B).

57. How many numbers of monochlorinated products are obtained by 3-ethylpentane

58. When 2-ethyl-3-methyl-1-pentene is treated with CH_3OH in H_2SO_4, how many different methoxy ethers would be formed in significant amount?

59. An organic compound $A(C_{10}H_{18}O_8)$ on treatment with excess of CH_3COCl gives a fully acetylated product whose molar mass is found to be 518 g/mol. How many hydroxyl functional groups are present in A?

60. How many different alcohol isomers with molecular formula $C_5H_{12}O$ can oxidised to ketones using $K_2Cr_2O_7$-H_2SO_4?

Section-III (MATHEMATICS)

[Section – A]

61. If S is the set of distinct values of 'b' for which the following system of linear equations
$x + y + z = 1$
$x + ay + z = 1$
$ax + by + z = 0$
has no solution, then S is:

(1) an empty set
(2) an infinite set
(3) a finite set containing two or more elements
(4) a singleton

62. The following statement
$(p \to q) \to [(\sim p \to q) \to q]$ is:

(1) a tautology
(2) equivalent to $\sim p \to q$
(3) equivalent to $p \to \sim q$
(4) a fallacy

63. If $5(\tan^2 x - \cos^2 x) = 2\cos 2x + 9$, then the value of $\cos 4x$ is:

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

(3) $\frac{2}{9}$ (4) $-\frac{7}{9}$

64. For three events A, B and C, P (Exactly one of A or B occurs) = P(Exactly one of B or C occurs) = P (Exactly one of C or A occurs) = $\frac{1}{4}$ and P(All the three events occur simultaneously) = $\frac{1}{16}$. Then the probability that at least one of the events occurs, is:

(1) $\frac{7}{32}$ (2) $\frac{7}{16}$

(3) $\frac{7}{64}$ (4) $\frac{3}{16}$

65. 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 k is equal to:

(1) $-z$ (2) z

(3) -1 (4) 1

66. Let k be an integer such that the triangle with vertices $(k, -3k)$, $(5, k)$ and $(-k, 2)$ has area 28 sq. units. Then the orthocentre of this triangle is at the point:

(1) $\left(2, -\frac{1}{2}\right)$ (2) $\left(1, \frac{3}{4}\right)$

(3) $\left(1, -\frac{3}{4}\right)$ (4) $\left(2, \frac{1}{2}\right)$

67. Twenty meters of wire is available for fencing off a flower-bed in the form of a circular sector. Then the maximum area (in sq. m) of the flower-bed, is:

(1) 12.5 (2) 10

(3) 25 (4) 30

68. If for $x \in \left(0, \frac{1}{4}\right)$, the derivative of $\tan^{-1}\left(\frac{6x\sqrt{x}}{1-9x^3}\right)$ is $\sqrt{x}.\ g(x)$, then $g(x)$ equals:

(1) $\frac{9}{1+9x^3}$ (2) $\frac{3x\sqrt{x}}{1+9x^3}$

(3) $\frac{3x}{1-9x^3}$ (4) $\frac{3}{1+9x^3}$

69. If $(2 + \sin x)\frac{dy}{dx} + (y + 1)\cos x = 0$ and $y(0) = 1$, then $y\left(\frac{\pi}{2}\right)$ is equal to:

(1) $\frac{1}{3}$ (2) $-\frac{2}{3}$

(3) $-\frac{1}{3}$ (4) $\frac{4}{3}$

70. If $A = \begin{bmatrix} 2 & -3 \\ -4 & 1 \end{bmatrix}$, then adj $(3A^2 + 12A)$ is equal to:

(1) $\begin{bmatrix} 72 & -84 \\ -63 & 51 \end{bmatrix}$ (2) $\begin{bmatrix} 51 & 63 \\ 84 & 72 \end{bmatrix}$

(3) $\begin{bmatrix} 51 & 84 \\ 63 & 72 \end{bmatrix}$ (4) $\begin{bmatrix} 72 & -63 \\ -84 & 51 \end{bmatrix}$

71. For any three positive real numbers a, b and c, $9(25a^2 + b^2) + 25(c^2 - 3ac) = 15b(3a + c)$. Then:

(1) b, c and a are in G.P.

(2) b, c and a are in A.P.

(3) a, b and c are in A.P.

(4) a, b and c are in G.P.

72. The eccentricity of an ellipse whose centre is at the origin is $\frac{1}{2}$. If one of its directrices is $x = -4$, then the equation of the normal to it at $\left(1, \frac{3}{2}\right)$ is:

(1) $2y - x = 2$ (2) $4x - 2y = 1$

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

73. A hyperbola passes through the point $P\left(\sqrt{2}, \sqrt{3}\right)$ and has foci at $(\pm 2, 0)$. Then the tangent to this hyperbola at P also passes through the point:

(1) $\left(3\sqrt{2}, 2\sqrt{3}\right)$

(2) $\left(2\sqrt{2}, 3\sqrt{3}\right)$

(3) $\left(\sqrt{3}, \sqrt{2}\right)$

(4) $\left(-\sqrt{2}, -\sqrt{3}\right)$

74. The function $f : R \to \left[-\frac{1}{2}, \frac{1}{2}\right]$ defined as $f(x) = \frac{x}{1+x^2}$, is:

(1) invertible

(2) injective but not surjective.

(3) surjective but not injective.

(4) neither injective nor surjective.

75. $\lim\limits_{x \to \frac{\pi}{2}} \frac{\cot x - \cos x}{(\pi - 2x)^3}$ equals:

(1) $\frac{1}{24}$ (2) $\frac{1}{16}$

(3) $\frac{1}{8}$ (4) $\frac{1}{4}$

76. The normal to the curve $y(x-2)(x-3) = x+6$ at the point where the curve intersects the y-axis passes through the point:

(1) $\left(-\frac{1}{2}, -\frac{1}{2}\right)$ (2) $\left(\frac{1}{2}, \frac{1}{2}\right)$

(3) $\left(\frac{1}{2}, -\frac{1}{3}\right)$ (4) $\left(\frac{1}{2}, \frac{1}{3}\right)$

77. If two different numbers are taken from the set {0, 1, 2, 3, …, 10}; then the probability that their sum as well as absolute difference are both multiple of 4, is:

(1) $\frac{6}{55}$ (2) $\frac{12}{55}$

(3) $\frac{14}{45}$ (4) $\frac{7}{55}$

78. The value of $({}^{21}C_1 - {}^{10}C_1) + ({}^{21}C_2 - {}^{10}C_2) + ({}^{21}C_3 - {}^{10}C_3) + ({}^{21}C_4 - {}^{10}C_4) + \ldots + ({}^{21}C_{10} - {}^{10}C_{10})$

(1) $2^{21} - 2^{11}$ (2) $2^{21} - 2^{10}$

(3) $2^{20} - 2^9$ (4) $2^{20} - 2^{10}$

79. A box contains 15 green and 10 yellow balls. If 10 balls are randomly drawn, one-by-one, with replacement, then the variance of the number of green balls drawn is:

(1) $\frac{12}{5}$ (2) 6

(3) 4 (4) $\frac{6}{25}$

80. The radius of a circle, having minimum area, which touches the curve $y = 4 - x^2$ and the lines, $y = |x|$ is:

(1) $2(\sqrt{2}+1)$ (2) $2(\sqrt{2}-1)$

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

[Section – B]

81. 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 A then $2A$ is equal to

82. If the image of the point $P(1, -2, 3)$ in the plane, $2x + 3y - 4z + 22 = 0$ measured parallel to the line, $\frac{x}{1} = \frac{y}{4} = \frac{z}{5}$ is Q, then PQ is β then $2\beta^2$ is equal to:

83. Let a vertical tower AB have its end A on the level ground. Let C be the mid-point of AB and P be a point on the ground such that $AP = 2AB$. If $\tan\beta = A$ then $81A^2$ is equal to

84. The distance of the point (1, 3, – 7) from the plane passing through the point (1, –1, – 1), having normal perpendicular to both the lines $\frac{x-1}{1} = \frac{y+2}{-2} = \frac{z-4}{3}$ and $\frac{x-2}{2} = \frac{y+1}{-1} = \frac{z+7}{-1}$, is $\frac{\alpha}{\sqrt{\beta}}$ then $\beta - \alpha$ is equal to

85. Let $I_n = \int \tan^n x\, dx, (n > 1)$. If $I_4 + I_6 = a\tan^5 x + bx^5 + C$, where C is a constant of integration, then $5a + b$ is equal to:

86. Let $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$ and $\vec{b} = \hat{i} + \hat{j}$. Let $\vec{c}$ be a vector such that $|\vec{c} - \vec{a}| = 3$, $|(\vec{a} \times \vec{b}) \times \vec{c}| = 3$ and the angle between $\vec{c}$ and $\vec{a} \times \vec{b}$ be 30°. Then $\vec{a} \cdot \vec{c}$ is equal to:

87. A man X has 7 friends, 4 of them are ladies and 3 are men. His wife Y also has 7 friends, 3 of them are ladies and 4 are men. Assume X and Y have no common friends. Then the total number of ways in which X and Y together can throw a party inviting 3 ladies and 3 men, so that 3 friends of each of X and Y are in this party, is:

88. Let $a, b, c \in R$. If $f(x) = ax^2 + bx + c$ is such that $a + b + c = 3$ and $f(x + y) = f(x) + f(y) + xy, \forall x, y \in R$, then $\sum_{n=1}^{10} f(n)$ is equal to:

89. If, for a positive integer n, the quadratic equation, $x(x+1) + (x+1)(x+2) + \ldots + (x + \overline{n-1})(x+n) = 10n$ has two consecutive integral solutions, then n is equal to:

90. The integral $\int_{\frac{\pi}{4}}^{\frac{3\pi}{4}} \frac{dx}{1+\cos x}$ is equal to: