JEE Mains (12th)

Sample Paper - II

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 period of the satellite of the earth orbiting very near to the surface of the earth is T_0. What is the period of the geostationary satellite in terms of T_0?

(1) $\frac{T_0}{\sqrt{7}}$ (2) $\sqrt{7}T_0$

(3) $7T_0$ (4) $7\sqrt{7}T_0$

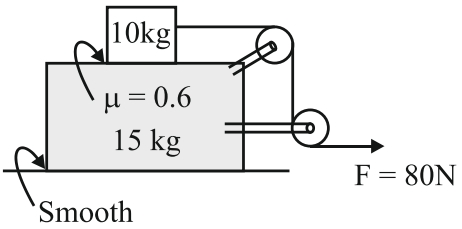
2. The circular head of a screw gauge is divided into 200 divisions and move 1 mm ahead in one revolution. If the same instrument has a zero error of –0.05 mm and the reading on the main scale in measuring diameter of a wire is 6 mm and that on circular scale is 45. The diameter of the wire is

(1) 6.275 mm
(2) 6.375 mm
(3) 5.75 mm
(4) 5.50 mm

3. If 10% of a radioactive material decays in 5 days, then the amount of the original material left after 20 days is approximately

(1) 60% (2) 65%
(3) 70% (4) 75%

4. A block of mass 15 kg is placed over a frictionless horizontal surface. Another block of mass 10 kg is placed over it, that is connected with a light string passing over two pulleys fastened to the 15 kg block. A force F = 80N is applied horizontally to the free end of the string. Friction coefficient between two blocks is 0.6. The portion of the string between 10 kg block and the upper pulley is horizontal. Pulley, string and connecting rods are massless. (Take g = 10 m/s^2).



The magnitude of acceleration of the 10 kg block is

(1) 3.2 m/s^2 (2) 2.0 m/s^2
(3) 1.6 m/s^2 (4) 0.8 m/s^2

5. Two rods of length d_1 and d_2 and coefficients of thermal conductivities K_1 and K_2 are kept touching each other in series. Both have the same area of cross-section, the equivalent of thermal conductivity is

(1) $K_1 + K_2$ (2) $K_1d_1 + K_2d_2$

(3) $\frac{d_1K_1 + d_2K_2}{d_1 + d_2}$ (4) $\frac{d_1 + d_2}{(d_1/K_1 + d_2/K_2)}$

6. A particle starts S.H.M. from the mean position. Its amplitude is *A* and total energy *E*. At one instant, its kinetic energy is 3E/4, its displacement at this instant is

(1) $y = \frac{A}{\sqrt{2}}$ (2) $y = \frac{A}{2}$

(3) $y = \frac{A}{\sqrt{3/2}}$ (4) $y = A$

7. Two long parallel wires P and Q are both perpendicular to the plane of the paper with distance of 5 m between them. If P and Q carry current of 2.5 amp and 5 amp respectively in the same directions, then the magnetic field at a point halfway between the wires is :

(1) $\frac{3\mu_0}{2\pi}$ (2) $\frac{\mu_0}{\pi}$

(3) $\frac{\sqrt{3}\mu_0}{2\pi}$ (4) $\frac{\mu_0}{2\pi}$

8. In a circuit L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45°. The value of C is

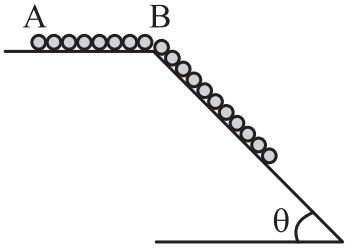
(1) $\frac{1}{\pi f(2\pi f L - R)}$ (2) $\frac{1}{2\pi f(2\pi f L - R)}$

(3) $\frac{1}{\pi f(2\pi f L + R)}$ (4) $\frac{1}{2\pi f(2\pi f L + R)}$

9. A physical quantity is expressed as velocity = $\sqrt{\frac{X}{\text{Density}}}$. The dimensions of X are

(1) $ML^{-1}T^{-2}$ (2) MLT^{-2}
(3) MLT^{-1} (4) $ML^{-1}T^{-3}$

10. A chain of length L and mass m is placed upon a smooth surface. The length of BA is (L–b). Calculate the velocity of the chain when its end *A* reaches *B*.



(1) $\sqrt{\frac{2g\sin\theta}{L}(L^2 - b^2)}$

(2) $2\sqrt{\frac{g\sin\theta}{L}(L^2 - b^2)}$

(3) $\sqrt{\frac{g\sin\theta}{L}(L^2 - b^2)}$

(4) $\sqrt{\frac{g\sin\theta}{2L}(L^2 - b^2)}$

11. Particles of masses m, 2m, 3m.....nm grams are placed on the same line at distances ℓ, 2ℓ, 3ℓ,.....$n\ell$ cm from a fixed point. The distance of centre of mass of the particles from the fixed point in centimeters is:

(1) $\frac{(2n+1)\ell}{3}$ (2) $\frac{\ell}{n+1}$

(3) $\frac{n(n^2+1)\ell}{2}$ (4) $\frac{2\ell}{n(n^2+1)}$

12. A projectile is moving at 60 m/s at its highest point, where it breaks into two equal parts due to an internal explosion. One part moves vertically up at 50 m/s with respect to the ground. The other part will move at-

(1) 110 m/s
(2) 120 m/s
(3) 130 m/s
(4) $10\sqrt{61}$ m/s

13. At a pressure of 24×10^5 dyne/cm^2, the volume of O_2 is 10 litre and mass is 20g. The r.m.s velocity will be–

(1) 800 m/s (2) 400 m/s
(3) 600 m/s (4) Data is incomplete

14. If 10 gram of ice at 0°C is mixed with 10 gram of water at 40°C. The final mass of water in mixture is (Latent heat of fusion of ice = 80 cal/gm; specific heat of water = 1 cal/gm °C)

(1) 10 gram (2) 15 gram
(3) 18 gram (4) 20 gram

15. Consider an YDSE that has different slits width, as a result, amplitudes of waves from two slits are A and 2A, respectively. If I_0 be the maximum intensity of the interference pattern, then intensity of the pattern at a point where phase difference between waves is ϕ, is:

(1) $I_0\cos^2\phi$ (2) $\frac{I_0}{3}\sin^2\frac{\phi}{2}$

(3) $\frac{I_0}{9}[5+4\cos\phi]$ (4) $\frac{I_0}{9}[5+8\cos\phi]$

16. The frequency of incident light falling on photo sensitive substance is doubled. If E_1 is the kinetic energy of emitted electron in first case and E_2 is the kinetic energy in second case, then:

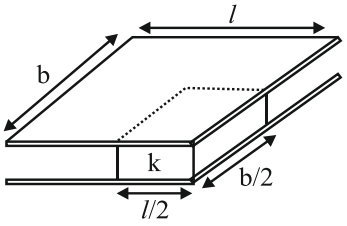
(1) $E_1 = E_2$ (2) $E_2 = 2E_1$
(3) $E_2 < 2E_1$ (4) $E_2 > 2E_1$

17. An object is moving along x-axis. It is definitely moving towards origin if :

(1) $\frac{dx}{dt} < 0$ (2) $\frac{dx}{dt} > 0$

(3) $x\frac{dx}{dt} < 0$ (4) $x\frac{dx}{dt} > 0$

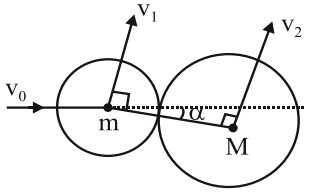
18. A slab of dielectric constant *K* is introduced inside a parallel plate capacitor of capacitance C as shown. The new capacitance is:



(1) $\frac{C}{2}(K+1)$ (2) $\frac{C}{4}(K+3)$

(3) $\frac{C}{2}(K+3)$ (4) $\frac{C}{4}(K+1)$

19. A smooth ball of mass m moving with the velocity v_o makes an elastic impact on another smooth ball of mass M at rest. After impact the velocity components v_1 and v_2 are:



(1) $v_0 \cos\alpha$, 0
(2) $v_0 \sin\alpha$, 0
(3) $v_0 \sin\alpha$, $v_0 \cos\alpha$
(4) none of these

20. The ratio of the speed of the electrons in the ground state of hydrogen to the speed of light in vacuum is:

(1) $\frac{1}{2}$ (2) $\frac{2}{237}$

(3) $\frac{1}{237}$ (4) $\frac{1}{137}$

[Section – B]

21. An insect trapped in a circular groove of radius 12 cm moves along the groove steadily and completes 7 revolutions in 100 sec. The linear speed is $\frac{n}{10}$ cm/sec. Then find the value of n is? (Take value of $\pi = 22/7$)

22. Six equal resistors are connected as series. Then they are connected in parallel. The ratio of equivalent resistances in both cases is:

23. The electric potential V is given as a function of distance x by $V=\left(5x^2+10x-9\right)$ volt. Positive value of electric field (in V/m) at x = 1m is

24. Three moles of an ideal monoatomic gas perform a cycle shown in figure. The gas temperatures in different states are T_1 = 200K, T_2 = 400K, T_3 = 1600 K, and T_4 = 800K. The work done (in kJ) by the gas during the cycle is (Take R = 25/3 J/mol- K)

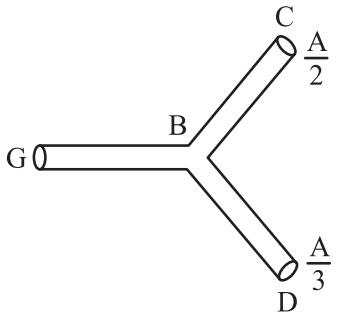
25. Two tuning forks are producing 6 beats/s. The frequency of first tuning fork is 256 Hz. Now, first tuning fork is loaded with wax. As a result the beat frequency becomes 4 beats/s. Now some portion of the wax is removed from first tuning fork. As a result the beat frequency becomes 0 beats/s. Then the frequency of first tuning fork after waxing (the condition when beat frequency is 4 beats/s) will be:

26. A convex lens is placed between a fixed object and a fixed screen. The distance between the object and the screen is 150 cm. The real images of the object are formed on the screen for two successive positions of the lens separated by a distance of 50 cm. The focal length of the lens in cm upto two decimals is:

27. In a Coolidge tube, the potential difference across the tube is 20 kV, and 10 mA current flows through the voltage supply. Only 0.5% of the energy carried by the electrons striking the target is converted into X-rays. The X-rays beam carries a power (in Watt) of –

28. The magnetic flux (ϕ) in a closed circuit of resistance 20Ω varies with time (t) according to the equation $\phi = 7t^2 - 4t$ where ϕ is in weber and t is in seconds. The magnitude of the induced current (in mA) at t = 0.25 s is:

29. A pipe GB is fitted with two pipes C and D as shown in the figure. The pipe has area A = 24 m^2 at G and velocity of water at G is 10 m/s, and at C is 6 m/s. The velocity of water at D is n × 7 m/sec, then n is:



30. A common emitter amplifier has a voltage gain of 50, an input impedance of 100Ω and an output impedance of 200Ω. The power gain of the amplifier is n × 250, then n is:

Section-II (CHEMISTRY)

[Section – A]

31. Which of the following compounds is formed in borax-bead test?
(1) Metaborate (2) Tetraborate
(3) Double oxide (4) Orthoborate

32. Which pair of ions are colourless
(1) Mn^{+3}, Co^{+3}
(2) Fe^{3+}, Cr^{+3}
(3) Zn^{2+}, Sc^{3+}
(4) Ti^{2+}, Cu^{2+}

33. Select the correct reactions with main products
(a) $NH_3 + Cl_2(Excess) \longrightarrow N_2$
(b) (conc.) $H_2SO_4 + HCOOH \longrightarrow CO$ (Carbon monoxide)
(c) $XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$
(d) $BCl_3 + 3H_2O \longrightarrow H_3BO_3 + 3HCl$
(1) a, b, c, d (2) a, b, d
(3) b, c, d (4) b, c

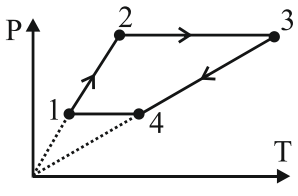
34. Total number of antibonding electron in N_2^+ is
(1) 6 (2) 5
(3) 4 (4) 2

35. Wrong match is

(1)	B < C < N < O	I^{st} IP
(2)	$Al^{+3} < Mg^{+2} < Na^+ < F^-$	Ionic radius
(3)	Li < Na < K	Metallic radius
(4)	I < Br < F < Cl	ΔHeg

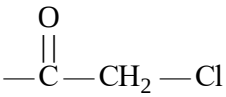
36. Which of the following match are incorrect
(a) Goldschmidt aluminothermite process-Cr_2O_3
(b) Mac Arther cyanide process - Fe
(c) Mond process - Ni
(d) Van Arkel process – Au
(1) a, c (2) c, d
(3) b, d (4) a, b

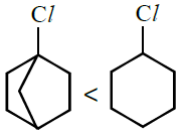
37. The correct name of the compound $[Cu(NH_3)_4](NO_3)_2$, according to IUPAC system is
(1) Cuprammonium nitrate
(2) Tetraamine copper (II) dinitrate
(3) Tetraammine copper (II) nitrate
(4) Tetraammine copper (I) dinitrate



38. Which of the following statement is not correct ?

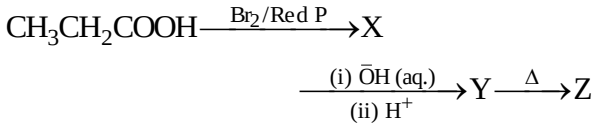
(1) Compound Ph–CH_2–Cl can undergo S_N1 & S_N2 reactions

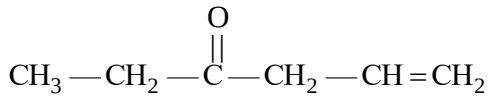
(2) For compound  Rate of S_N2 < Rate of S_N1

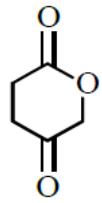
(3) Rate of S_N1 

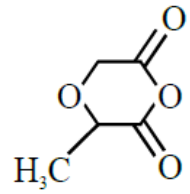
(4) Compound CH_3 –Cl will prefer to undergo S_N2 when reacting with aq. KOH

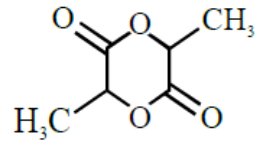
39. What is the product (Z) in given sequence of reactions?



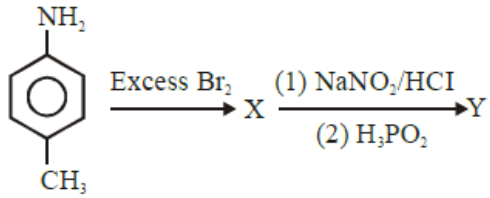
(1) 

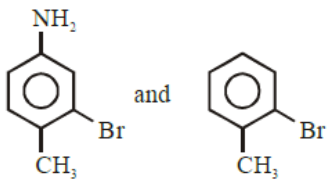
(2) 

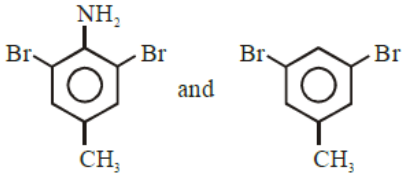
(3) 

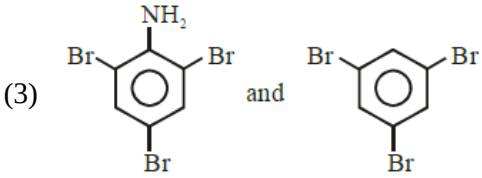
(4) 

40. In the following reaction sequence, predict the compounds X and Y



(1) 

(2) 

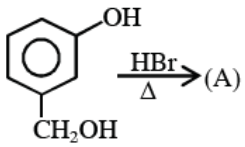
(3) 

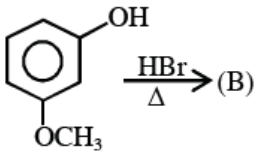
(4) None of these

41. Among the following, narcotic analgesic is

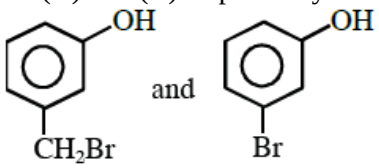
(1) Ibuprofen (2) Morphine

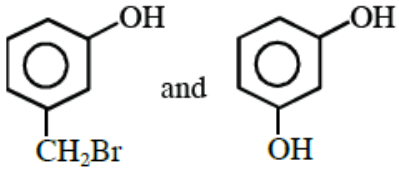
(3) Aspirin (4) Naproxen

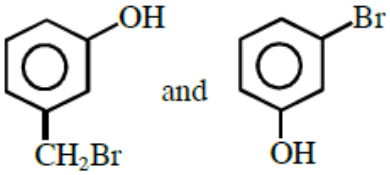
42. 

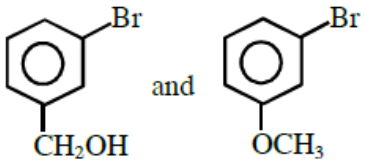


Product (A) and (B) respectively are

(1) 

(2) 

(3) 

(4) 

43. The face centered cubic cell of platinum has a length of 0.392 nm. Calculate the density of platinum (g/cm^3): (Atomic weight : Pt = 195)

(1) 2.09 (2) 30.6

(3) 7.9 (4) 21.5

44. Which of the following statement is not correct ?

(1) Physical adsorption is due to Vander Waal's forces

(2) Physical adsorption is irreversible

(3) Chemical adsorption increases with increase in temperature upto certain limit then decreases

(4) Enthalpy of adsorption (|ΔH|) for a chemical adsorption is greater than that of physical adsorption

45. For a first order reaction A → Products, the concentration of [A] is reduced from 1M to 0.125 M in one hour, the $t_{1/2}$ of this reaction (in sec) is

(1) 600 (2) 300
(3) 1200 (4) 0.693/1200

46. In which of the following combination, is buffer action expected?

(a) $NH_4OH + NH_4Cl$
(b) HCl + NaCl
(c) NH_4OH + HCl in 2 : 1 mole ratio

Select the correct answer using the code given below

(1) a & b (2) a & c
(3) a, b & c (4) None of these

47. Calculate the standard enthalpy of formation of $CH_3OH_{(l)}$ from the following data

$$CH_3OH(l) + \frac{3}{2}O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)};$$

$\Delta H° = -726$ KJ mol^{-1}

$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$; $\Delta H° = -393$ KJ mol^{-1}

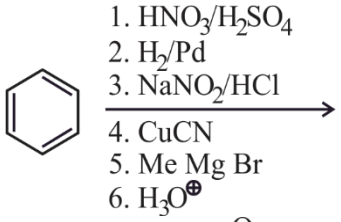
$$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)};\ \Delta H° = -286 \text{ KJ mol}^{-1}$$

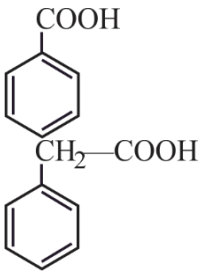
(1) +310 KJ mol^{-1} (2) –310 KJ mol^{-1}
(3) –239 KJ mol^{-1} (4) +239 KJ mol^{-1}

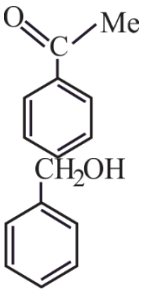
48. The acidic form of the indicator is red and the basic form is yellow. Calculate the pH change required to change the colour of the indicator from 90% red to 90% yellow. K_a for indicator = 1.0×10^{-6} (log 3 = 0.48)

(1) 0.96 (2) 0.48
(3) 1.92 (4) None of these

49. Give the product of the following reaction sequence



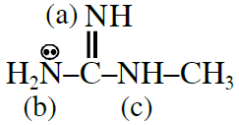
(1) 

(2) 

(3)

(4)

50. Which of the following nitrogen atom is maximum basic?



(1) b (2) a
(3) c (4) All are same

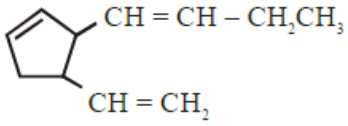
[Section – B]

51. Number of H_2O molecules attached as ligand in $CuSO_4.5H_2O$ = x
Number of 90° bond angles in XeF_4 = y
Number of ions in the aqueous solutions of $[Pt(NH_3)_6]Cl_4$ = z find (x + y + z) = ?

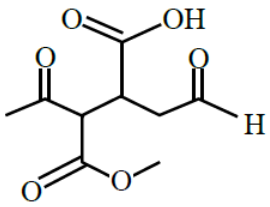
52. If Ni(CO)x, Fe(CO)y, Kz$[Fe(CN)_6]$
Follow the EAN rule then find (x + y + z)?

53. Sum of d-orbitals used in the hybridization of PCl_5, SF_6, IF_7 and CCl_4.

54. Total number of stereoisomers possible for following compound is



55. Total number of enol possible for the compound formed during given reaction will be (including stereoisomer)

56. 

The above given compound find out sum of functional group reduced by LAH (Lithium aluminium hydride) and SBH (sodium borohydride) respectively?

57. Two liquids A and B have $P°_A$ and $P°_B$ in the ratio of 1 : 3 and the ratio of number of moles of A and B in liquid phase are 1 : 3 then mole fraction of 'A' is $\frac{x}{10}$ in vapour phase in equilibrium with the solution then value of x is

58. The equilibrium constant for the following general reaction is 10^{30}. Value of E° for the cell $\frac{x}{10}$ at 25°C then calculate the value of x.

$$2X_{(s)} + 3Y^{+2}_{(aq)} \rightarrow 2X^{+3}_{(aq)} + 3Y_{(s)}$$

59. On passing electric current through molten $AlCl_3$, 11.2 litre of Cl_2 is liberated at N.T.P. at anode. The quantity of aluminium deposited at cathode is (At.wt. of Al = 27)

60. CH_3COOH has the dissociation constant 1×10^{-5}. It forms a salt CH_3COONa on reaction with NaOH. The percentage degree of hydrolysis of 0.1M solution of CH_3COONa is $x \times 10^{-2}$ then calculate value of x.

Section-III (MATHEMATICS)

[Section – A]

61. If the four complex numbers $z, \bar{z}, \bar{z} - 2\,\mathrm{Re}(\bar{z})$ and $z - 2\mathrm{Re}(z)$ represent the vertices of a square of side 4 units in the Argand plane, then $|z|$ is equal to:

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

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

62. The negation of the Boolean expression $x \leftrightarrow \sim y$ is equivalent to

(1) $(x \wedge \sim y) \vee (\sim x \wedge y)$

(2) $(\sim x \wedge y) \vee (\sim x \wedge \sim y)$

(3) $(x \wedge y) \wedge (\sim xV \sim y)$

(4) $(x \wedge y) \vee (\sim x \wedge \sim y)$

63. If $2^{10} + 2^9 \cdot 3^1 + 2^8 \cdot 3^2 + \ldots + 2 \cdot 3^9 + 3^{10} = S - 2^{11}$, then S is equal to

(1) $\frac{3^{11}}{2} + 2^{10}$ (2) $3^{11} - 2^{12}$

(3) 2.3^{11} (4) 3^{11}

64. Let $\lambda \in R$. The system of linear equations.

$2x_1 - 4x_2 + \lambda x_3 = 1$

$x_1 - 6x_2 + x_3 = 2$

$\lambda x_1 - 10x_2 + 4x_3 = 3$

Is inconsistent for:

(1) exactly one positive value of λ

(2) exactly one negative value of λ

(3) every value of λ

(4) exactly two values of λ

65. If $\int (e^{2x} + 2e^x - e^{-x} - 1)e^{(e^x + e^{-x})}dx = g(x)e^{(e^x + e^{-x})} + c$ where c is a constant of integration, then $g(0)$ is equal to:

(1) e (2) 2

(3) e^2 (4) 1

66. If $3^{2\sin 2\alpha - 1}$, 14 and $3^{4 - 2\sin 2\alpha}$ are the first three terms of an *AP* for some α, then the sixth term of this *AP* is:

(1) 65 (2) 78

(3) 66 (4) 81

67. A survey shows that 73% of the persons working in an office like coffee, whereas 65% like tea. If x denotes the percentage of them, who like both coffee and tea, then x cannot be:

(1) 63 (2) 54

(3) 38 (4) 36

68. If the common tangent to the parabolas $y^2 = 4x$ and $x^2 = 4y$ also touches the circle, $x^2 + y^2 = c^2$, then c is equal to

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

(3) $\frac{1}{2}$ (4) $\frac{1}{4}$

69. The product of the roots of the equation $9x^2 - 18|x| + 5 = 0$, is:

(1) 5/9 (2) 25/9

(3) 5/27 (4) 25/81

70. The value of $\int_{-\pi/2}^{\pi/2} \frac{1}{1 + e^{\sin x}}\,dx$ is:

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

(3) π (4) $\frac{\pi}{4}$

71. If S is the sum of the first 10 terms of the series $\tan^{-1}\left(\frac{1}{3}\right) + \tan^{-1}\left(\frac{1}{7}\right) + \tan^{-1}\left(\frac{1}{13}\right) + \tan^{-1}\left(\frac{1}{21}\right) + \ldots$, then $\tan(S)$ is equal to:

(1) $\frac{5}{6}$ (2) $\frac{10}{11}$

(3) $\frac{6}{5}$ (4) $\frac{5}{11}$

72. If (a, b, c) is the image of the point $(1, 2, -3)$ in the line, $\frac{x+1}{2} = \frac{y-3}{-2} = \frac{z}{-1}$, then $a + b + c$ is equal to

(1) 3 (2) 1

(3) 2 (4) –1

73. If $y = y(x)$ is the solution of the differential equation $\frac{5 + e^x}{2 + y} \cdot \frac{dy}{dx} + e^x = 0$ satisfying $y(0) = 1$, then a value $y(\log_e 13)$ is:

(1) 0

(2) 1

(3) –1

(4) 2

74. If α is the positive root of the equation, $p(x) = x^2 - x - 2 = 0$, then $\lim_{x \to \infty} \frac{\sqrt{1 - \cos(p(x))}}{x + \alpha - 4}$ is equal to:

(1) $1/\sqrt{2}$

(2) 1 / 2

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

(4) 3 / 2

75. If the co-ordinates of two points A and B are $(\sqrt{7},0)$ and $(-\sqrt{7},0)$ respectively and P is any point on the conic $9x^2 + 16y^2 = 144$, then $PA + PB$ is equal to:

(1) 8 (2) 16

(3) 9 (4) 6

76. If the function $f(x) = \begin{cases} k_1(x-\pi)^2 - 1 & ; x \le \pi \\ k_2 \cos x & ; x > \pi \end{cases}$ is twice differentiable, then the ordered pair (k_1, k_2) is equal to:

(1) (1, 0) (2) (1, 1)

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

77. If the minimum and the maximum values of the function $f : \left[\frac{\pi}{4}, \frac{\pi}{2}\right] \to R$, defined by $f(\theta) = \begin{vmatrix} -\sin^2\theta & -1-\sin^2\theta & 1 \\ -\cos^2\theta & -1-\cos^2\theta & 1 \\ 12 & 10 & -2 \end{vmatrix}$ are m and M respectively, then the ordered pair (m, M) is equal to:

(1) (0, 4) (2) $(0, 2\sqrt{2})$

(3) (–4, 4) (4) (–4, 0)

78. The mean and variance of 7 observations are 8 and 16, respectively. If five observations are 2, 4, 10, 12, 14, then the absolute difference of the remaining two observations is:

(1) 2 (2) 4

(3) 1 (4) 3

79. If the point P on the curve, $4x^2 + 5y^2 = 20$ is farthest from the point $Q(0, -4)$ then PQ^2 is equal to:

(1) 21 (2) 48

(3) 36 (4) 29

80. If the volume of a parallelepiped, whose coterminous edges are given by the vectors $\vec{a} = \hat{i} + \hat{j} + n\hat{k}, \vec{b} = 2\hat{i} + 4\hat{j} - n\hat{k}$ and $\vec{c} = \hat{i} + n\hat{j} + 3\hat{k} (n \ge 0)$, is 158 cu. units. then:

(1) $\vec{a} \cdot \vec{c} = 14$ (2) $n = 7$

(3) $\vec{b} \cdot \vec{c} = 10$ (4) $n = 9$

[Section – B]

81. The natural number m, for which the coefficient of x in the binomial expansion of $\left(x^m + \frac{1}{x^2}\right)^{22}$ is 1540, is

82. Let $f(x) = x \cdot \left[\frac{x}{2}\right]$, for $-10 < x < 10$, where $[t]$ denotes the greatest integer function. Then the number of points of discontinuity of f is equal to _____ .

83. If the line, $2x - y + 3 = 0$ is at a distance $\frac{1}{\sqrt{5}}$ and $\frac{2}{\sqrt{5}}$ from the lines $4x - 2y + \alpha = 0$ and $6x - 3y + \beta = 0$, respectively, then the sum of all possible values of α and β is _____ .

84. Four fair dice are thrown independently 27 times. Then the expected number of times, at least two dice show up a three or a five, a _____ .

85. The number of words, with or without meaning, that can be formed by taking 4 letters at a time from the letters of the word 'SYLLABUS' such that two letters are distinct and two letters are alike, is _____ .

86. If $x_k = (\sec\theta)^{2^{\frac{1}{k}}} + (\tan\theta)^{2^{\frac{1}{k}}}$ and $y_k = (\sec\theta)^{2^{\frac{1}{k}}} - (\tan\theta)^{2^{\frac{1}{k}}}$, then value of $3y_n \prod_{k=0}^{n} (x_k)$ is equal to.

87. If the range of function $f(x) = (\pi\sqrt{2} + \cos^{-1}\alpha)x^2 + 2(\cos^{-1}\beta)x + \pi\sqrt{2} - \cos^{-1}\alpha$ is $[0, \infty]$ then find the value of $|\alpha - \beta| + 2\alpha\beta + 1$.

88. $\tan46^\circ \tan14^\circ - \tan74^\circ \tan14^\circ + \tan74^\circ \tan46^\circ$ is equal to

89. In a ΔABC, if $r_1 + r_3 + r = r_2$, then find the vlaue of $(\sec^2 A + \cos^2 B - \cot^2 C)$.

90. If $z_1, z_2 \in C$, $z_1^2 + z_2^2 \in R$, $z_1\left(z_1^2 - 3z_2^2\right) = 2$ and $z_2\left(3z_1^2 - z_2^2\right) = 11$, the value of $z_1^2 + z_2^2$ is