MANAS JEE TEST SERIES -1

INSTRUCTIONS

1. This test will be a 3 hour Test.

2 This test consists of Physics, Chemistry and Mathematics questions with equal weightage of 100 marks.

3. Each question is of 4 marks.

4. There are three sections in the question paper consisting of Physics (Q.no.1 to 25), Chemistry (Q.no.26 to 50) and Mathematics (Q. no.51 to 75). Each section is divided into two parts, Part I consists of 20 multiple choice questions & Part II consists of 5 Numerical value type Questions.

5. There will be only one correct choice in the given four choices in Part I. For each question 4 marks will be awarded for correct choice, I mark will be deducted for incorrect choice for Part I Questions and zero mark will be awarded for not attempted question. For Part II Questions 4 marks will be awarded for correct answer and zero for unattempted and incorrect answer.

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

7.All calculations/written work should be done in the rough sheet provided.

PHYSICS

PART-I (Multiple Choice Questions)

1. Two stars each of mass M and radius R are approaching each other for a head-on collision. They start approaching each other when their separation is $r >> R$. If their speeds at this separation are negligible, the speed v with which they collide would be

(a) $v = \sqrt{GM\left(\frac{1}{R} - \frac{1}{r}\right)}$

(b) $v = \sqrt{GM\left(\frac{1}{2R} - \frac{1}{r}\right)}$

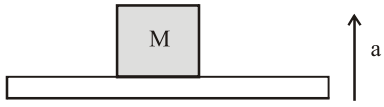
(c) $v = \sqrt{GM\left(\frac{1}{R} + \frac{1}{r}\right)}$

(d) $v = \sqrt{GM\left(\frac{1}{2R} + \frac{1}{r}\right)}$

2. A block of mass M is kept on a platform which is accelerated upward with a constant acceleration 'a' during the time interval T. The work done by

Space for Rough Work

normal reaction between the block and platform is



(a) $-\frac{MgaT^2}{2}$

(b) $\frac{1}{2}M(g+a)aT^2$

(c) $\frac{1}{2}Ma^2T$

(d) Zero

3. A large number of water drops each of radius r combine to have a drop of radius R. If the surface tension is T and the mechanical equivalent of heat is J, then the rise in temperature will be

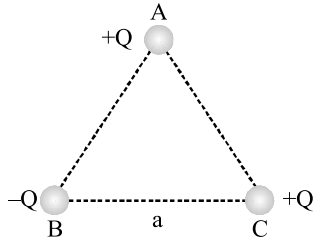
(a) $\frac{2T}{rJ}$

(b) $\frac{3T}{RJ}$

(c) $\frac{3T}{J}\left(\frac{1}{r}-\frac{1}{R}\right)$

(d) $\frac{2T}{J}\left(\frac{1}{r}-\frac{1}{R}\right)$

4. Three charges are placed at the vertices of an equilateral triangle of side 'a' as shown in the following figure. The force experienced by the charge placed at the vertex A in a direction normal to BC is



(a) $Q^2/(4\pi\varepsilon_0 a^2)$

(b) $-Q^2/(4\pi\varepsilon_0 a^2)$

(c) Zero

(d) $Q^2/(2\pi\varepsilon_0 a^2)$

5. Axis of a solid cylinder of infinite length and radius R lies along y-axis, it carries a uniformly distributed current i along +y direction. Magnetic field at a point $\left(\frac{R}{2}, y, \frac{R}{2}\right)$ is

(a) $\frac{\mu_0 i}{4\pi R}(\hat{i}-\hat{k})$

(b) $\frac{\mu_0 i}{2\pi R}(\hat{j}-\hat{k})$

(c) $\frac{\mu_0 i}{4\pi R}\hat{j}$

(d) $\frac{\mu_0 i}{4\pi R}(\hat{i}+\hat{k})$

6. Two identical short bar magnets, each having magnetic moment of 10 Am^2, are arranged such that their axial lines are perpendicular to each other and their centres be along the same straight line in a horizontal plane. If the distance between their centres is 0.2 m, the

Space for Rough Work

resultant magnetic induction at a point midway between them is ($\mu_0 = 4\pi \times 10^{-7}\ \text{Hm}^{-1}$)

(a) $\sqrt{2} \times 10^{-7}$ tesla

(b) $\sqrt{5} \times 10^{-7}$ tesla

(c) $\sqrt{2} \times 10^{-3}$ tesla

(d) $\sqrt{5} \times 10^{-3}$ tesla

7. Two boys are standing at the ends A and B of a ground where $AB = a$. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at A starts running simultaneously with velocity v and catches the other boy in a time t, where t is

(a) $a/\sqrt{v^2 + v_1^2}$

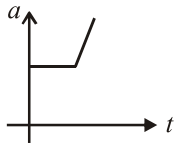
(b) $a/(v + v_1)$

(c) $a/(v - v_1)$

(d) $\sqrt{a^2/(v^2 - v_1^2)}$

8. A block is placed on a rough horizontal plane. A time dependent horizontal force $F = kt$ acts on the block. Here, k is a positive constant. The acceleration-time graph of the block is

(a)



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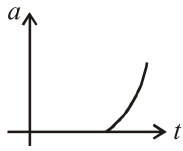

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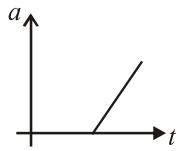

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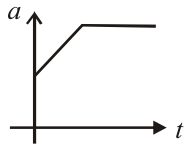


9. A new system of units is proposed in which unit of mass is α kg, unit of length is β m and unit of time is γ s. What wil be value of 5 J in this new system?

(a) $5\alpha\beta^2\gamma^{-2}$

(b) $5\alpha^{-1}\beta^{-2}\gamma^2$

(c) $5\alpha^{-2}\beta^{-1}\gamma^{-2}$

(d) $5\alpha^{-1}\beta^2\gamma^2$

10. Television signals on earth cannot be received at distances greater than 100 km from the transmission station. The reason behind this is that

(a) the receiver antenna is unable to detect the signal at a disance greater than 100 km

(b) the TV programme consists of both audio and video signals

(c) the TV signals are less powerful than radio signals

(d) the surface of earth is curved like a sphere

Space for Rough Work

11. A sinusoidal voltage of amplitude 25 volt and frequency 50Hz is applied to a half wave rectifier using P-n junction diode. No filter is used and the load resistor is 1000Ω. The forward resistance R_f of ideal diode is 10Ω. The percentage rectifier efficiency is

(a) 40% (b) 20%

(c) 30% (d) 15%

12. When photon of energy 4.25 *e*V strike the surface of a metal A, the ejected photoelectrons have maximum kinetic energy T_A eV and de-Brolie wavelength λ_A. The maximum kinetic energy of photoelectrons liberated from another metal B by photon of energy 4.70 eV is $T_B = (T_A - 1.50)$ *e*V. If the de-Broglie wavelength of these photoelectrons is $\lambda_B = 2\lambda_A$, then

(a) the work function of A is 3.40 *e*V

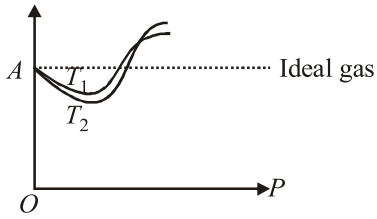
(b) the work function of B is 6.75 *e*V

(c) $T_A = 2.00$ *e*V

(d) $T_B = 2.75$ *e*V

13. Given is the graph between $\frac{PV}{T}$ and P for 1 g of oxygen gas at two different temperatures T_1 and T_2, as shown in figure. Given, density of oxygen = 1.427 kg m^{-3}. The value of PV/T at the point A and the relation between T_1 and T_2 are respectively

$\frac{PV}{T}$ J k^{-1}



(a) 0.259 J K^{-1} and $T_1 < T_2$

(b) 8.314 J mol^{-1} K^{-1} and $T_1 > T_2$

(c) 0.259 J K^{-1} and $T_1 > T_2$

(d) 4.28 g J K^{-1} and $T_1 < T_2$

14. An observer moves towards a stationary source of sound with a speed 1/5th of the speed of sound. The wavelength and frequency of the sound emitted are λ and f respectively. The apparent frequency and wavelength recorded by the observer are respectively.

(a) 0.8f, 0.8λ (b) 1.2f, 1.2λ

(c) 1.2f, λ (d) f, 1.2λ

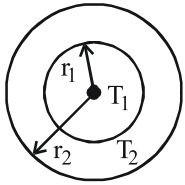
15. The figure shows a system of two concentric spheres of radii r_1 and r_2 are kept at temperatures T_1 and T_2, respectively. The radial rate of flow of heat in a substance between the two concentric spheres is proportional to

(a) $In\left(\frac{r_2}{r_1}\right)$

(b) $\frac{(r_2 - r_1)}{(r_1 r_2)}$

(c) $(r_2 - r_1)$

(d) $\frac{r_1 r_2}{(r_2 - r_1)}$



Space for Rough Work

16. A gas is compressed isothermally to half its initial volume. The same gas is compressed separately through an adiabatic process until its volume is again reduced to half. Then :

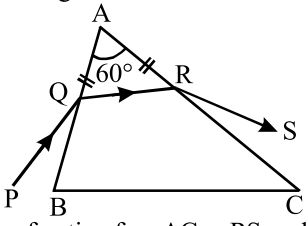
(a) Compressing the gas isothermally will require more work to be done.

(b) Compressing the gas through adiabatic process will require more work to be done.

(c) Compressing the gas isothermally or adiabatically will require the same amount of work.

(d) Which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas.

17. A ray PQ incident on the refracting face BA is refracted in the prism BAC as shown in the figure and emerges from the other



refracting face AC as RS such that AQ = AR. If the angle of prism A = 60° and the refractive index of the material of prism is $\sqrt{3}$, then the angle of deviation of the ray is

(a) 60°

(b) 45°

(c) 30°

(d) None of these

18. Which of the following has/have zero average value in a plane electromagnetic wave ?

(a) Both magnetic and electric field

(b) Electric field only

(c) Magnetic energy

(d) Electric energy

19. Two inductors L_1 (inductance 1 mH, internal resistance 3Ω) and L_2 (inductance 2 mH, internal resistance 4Ω), and a resistor R (resistance 12Ω) are all connected in parallel across a 5V battery. The circuit is switched on a time t = 0. The ratio of the maximum to the minimum current (I_{max}/I_{min}) drawn from the battery is

(a) 8 (b) 10

(c) 12 (d) 14

20. In a diffraction pattern due to a single slit of width 'a', the first minimum is observed at an angle 30° when light of wavelength 5000 Å is incident on the slit. The first secondary maximum is observed at an angle of :

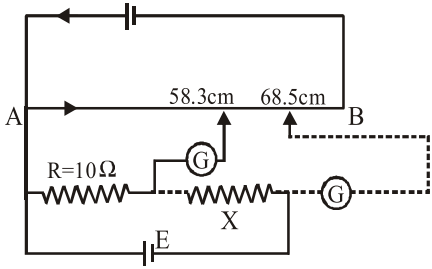
(a) $\sin^{-1}\left(\frac{1}{4}\right)$ (b) $\sin^{-1}\left(\frac{2}{3}\right)$

(c) $\sin^{-1}\left(\frac{1}{2}\right)$ (d) $\sin^{-1}\left(\frac{3}{4}\right)$

PART-II (Numerical Answer Questions)

21. Figure shows use of potentiometer for comparison of two resistances. The balance point with standard resistance R = 10Ω is at 58.3 cm, while that with unknown resistance X is 68.5 cm. Find X (in Ω).

Space for Rough Work



22. An automobile moves on a road with a speed of 54 km h^{-1}. The radius of its wheels is 0.45 m and the moment of inertia of the wheel about its axis of rotation is 3 kg m^2. If the vehicle is brought to rest in 15s, the magnitude of average torque (in kgm^2s^{-2}) transmitted by its brakes to the wheel is :

23. A coil of effective area 4 m^2 is placed at right angles to the magnetic induction B. The e.m.f. of 0.32 V is induced in the coil. When the field is reduced to 20% of its initial value in 0.5 sec. Find B (in wb/m^2).

24. A disc of radius $R = 10$ cm oscillates as a physical pendulum about an axis perpendicular to the plane of the disc at a distance r from its centre. If $r = \frac{R}{4}$, the approximate period of oscillation (in second) is (Take $g = 10\ m\ s^{-2}$)

25. Taking the wavelength of first Balmer line in hydrogen spectrum (n = 3 to n = 2) as 660 nm, the wavelength (in nm) of the 2nd Balmer line (n = 4 to n = 2) will be;

CHEMISTRY

PART-I (Multiple Choice Questions)

26. Which of the following has the highest $p\pi - p\pi$ bonding tendency?
(a) N (b) P
(c) As (d) Sb

27. Among the following, the compound that is both paramagnetic and coloured, is
(a) $KMnO_4$
(b) CuF_2
(c) $K_2Cr_2O_7$
(d) All are coloured

28. The bond angle between two hybrid orbitals is 105°. The percentage of *s*-character of hybrid orbital is between
(a) 50 - 55% (b) 9 - 12%
(c) 21 - 23% (d) 11 - 12%

29. Identify Z in the following sequence of reactions –

$$CH_3 - COONH_4 \xrightarrow{\Delta} X \xrightarrow{P_2O_5} Y \xrightarrow{H_2O/H^{\oplus}} Z$$

(a) $CH_3 - CH_2 - CO - NH_2$
(b) $CH_3 - CN$
(c) $(CH_3CO)_2O$
(d) $CH_3 - COOH$

30. Correct order of first IP among following elements Be, B, C, N, O is
(a) B < Be < C < O < N
(b) B < Be < C < N < O
(c) Be < B < C < N < O
(d) Be < B < C < O < N

Space for Rough Work

31. Select the rate law that corresponds to data shown for the following reaction

$A + B \longrightarrow$ products.

Exp.	[A]	[B]	Initial rate
1	0.012	0.035	0.1
2	0.024	0.070	0.8
3	0.024	0.035	0.1
4	0.012	0.070	0.8

(a) rate = k [B]^3

(b) rate = k [B]^4

(c) rate = k [A] [B]^3

(d) rate = k [A]^2 [B]^2

32. The pH of 0.1 M solution of the following species increases in the order :

(a) $NaCl < NH_4Cl < NaCN < HCl$

(b) $HCl < NH_4Cl < NaCl < NaCN$

(c) $NaCN < NH_4Cl < NaCl < HCl$

(d) $HCl < NaCl < NaCN < NH_4Cl$

33. Aldehydes and ketones are distinguished by which of the following test ?

(a) Lucas test

(b) Tollen's test

(c) $KMnO_4$ solution (Baeyer's test)

(d) None of these

34. Which is not a true statement?

(a) α-Carbon of α-amino acid is asymmetric

(b) All proteins are found in L-form

(c) Human body can synthesize all proteins they need

(d) At pH = 7 both amino and carboxylic groups exist in ionised form

35. Which of the following products are obtained when Na_2CO_3 is added to a solution of copper sulphate ?

(a) Basic copper carbonate [$CuCO_3.Cu(OH)_2$], sodium sulphate and CO_2.

(b) Copper hydroxide, sodium sulphate and CO_2.

(c) Copper carbonate, sodium sulphate and CO_2.

(d) Copper carbonate and sodium sulphate.

36. Which of the following statement is incorrect with respect to metallic or electronic conductivity?

(a) Metallic conductivity depends on the structure of metal and its charactristics.

(b) Metallic conductivity depends on the number of electrons in the valence shell of atom of metal.

(c) The electrical conductivity of metal increases with increase in temperature.

(d) There is no change in the structure of metal during electrical conduction.

37. A solid has a structure in which 'W' atoms are located at the corners of a cubic lattice, 'O' atoms at the centre of edges and Na atoms at the centre of the cube. The formula for the compound is

(a) Na_2WO_3 (b) Na_2WO_2

(c) $NaWO_2$ (d) $NaWO_3$

Space for Rough Work

38. When phenol is treated with excess bromine water. It gives
(a) *m*-Bromophenol
(b) *o*-and *p*-Bromophenols
(c) 2,4-Dibromophenol
(d) 2,4, 6-Tribromophenol.

39. Given below, catalyst and corresponding process/reaction are matched. The one with mismatch is
(a) $[RhCl(PPh_3)_2]$: Hydrogenation
(b) $TiCl_4 + Al(C_2H_5)_3$: Polymerization
(c) V_2O_5 : Haber-Bosch process
(d) Nickel : Hydrogenation

40. The molecule which has zero dipole moment is :
(a) CH_3Cl (b) NF_3
(c) BF_3 (d) ClO_2^-

41. One mole of NaCl (*s*) on melting absorbed 30.5 kJ one of heat and its entropy is increased by 28.8 $JK^{-1}mol^{-1}$. The melting point of NaCl is
(a) 1059 K (b) 30.5 K
(c) 28.8 K (d) 28800 K

42. Which alkene on ozonolysis gives CH_3CH_2CHO and $CH_3\overset{\overset{O}{\|}}{C}CH_3$?
(a) $CH_3CH_2CH=C(CH_3)(CH_3)$
(b) $CH_3CH_2CH=CHCH_2CH_3$
(c) $CH_3CH_2CH=CHCH_3$
(d) $CH_3-C(CH_3)=CHCH_3$

43. On reduction of $KMnO_4$ by oxalic acid in acidic medium, the oxidation number of Mn changes. What is the magnitude of this change?
(a) From 7 to 2 (b) From 6 to 2
(c) From 5 to 2 (d) From 7 to 4

44. The half-life for radioactive decay of C–14 is 5730 years. An archaeological artifact containing wood had only 80% of the C–14 found in a living tree. The age of the sample is
(a) 1485 years (b) 1845 years
(c) 530 years (d) 4767 years.

45. Which one of the following complexes is an outer orbital complex ?
(a) $[Co(NH_3)_6]^{3+}$
(b) $[Mn(CN)_6]^{4-}$
(c) $[Fe(CN)_6]^{4-}$
(d) $[Ni(NH_3)_6]^{2+}$
(Atomic nos. : Mn = 25; Fe = 26; Co = 27, Ni = 28)

PART-II (Numerical Answer Questions)

46. If pressure of a gas is reduced by 25%, then what should be the temperature required to make its volume twice at NTP?

47. An aromatic compound of formula C_7H_7Cl has in all ..... isomers :

48. Calculate the volume strength of 1.5 NH_2O_2 solution.

49. A metal crystallizes into a lattice containing a sequence of layers of atoms of ABABAB.....What percentage by volume of this lattice has empty space?

50. In an experiment, 4 g of M_2O_x oxide was reduced to 2.8 g of the metal. Calculate the number of O atoms in the oxide.
(Given : Atomic mass of the metal = 56 g mol^{-1})

Space for Rough Work

MATHEMATICS

PART-I (Multiple Choice Questions)

51. If the coefficient of 4^{th} term in the expansion of $\left(x+\frac{\alpha}{2x}\right)^n$ is 20, then the respective values of α and n are

(a) 2, 7 (b) 5, 8
(c) 3, 6 (d) 2, 6

52. If the roots of the quadratic equation $x^2+px+q=0$ are tan 30° and tan 15°, respectively, then the value of $2+q-p$ is

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

53. If a^2, b^2, c^2 are in A.P. then $\frac{1}{b+c}, \frac{1}{c+a}, \frac{1}{a+b}$ are in-

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

54. Let C be the circle with centre (0, 0) and radius 3 units. The equation of the locus of the mid points of the chords of the circle C that subtend an angle of $\frac{2\pi}{3}$ at its center is

(a) $x^2+y^2=\frac{3}{2}$

(b) $x^2+y^2=1$

(c) $x^2+y^2=\frac{27}{4}$

(d) $x^2+y^2=\frac{9}{4}$

55. If $y=\tan^{-1}\left(\frac{\log_e(e/x^2)}{\log_e(ex^2)}\right)+\tan^{-1}\left(\frac{3+2\log_e x}{1-6\log_e x}\right)$, then $\frac{d^2y}{dx^2}$ is

(a) 2 (b) 1
(c) 0 (d) –1

56. If $\{\ \}$ denotes the fractional part of x, the range of the function $f(x)=\sqrt{\{x\}^2-2\{x\}}$ is

(a) ϕ (b) [0, 1/2]
(c) {0, 1/2} (d) {0}

57. The length of the perpendicular from the origin to a line is 7 and line makes an angle of 150° with the positive direction of y-axis, then the equation of the line is

(a) $\sqrt{3}\,x+y=7$

(b) $\sqrt{3}\,x-y=14$

(c) $\sqrt{3}\,x+y+14=0$

(d) $\sqrt{3}\,x+y-14=0$

58. $\int\frac{dx}{\cos x+\sqrt{3}\sin x}$ equals

(a) $\log\tan\left(\frac{x}{2}+\frac{\pi}{12}\right)+C$

(b) $\log\tan\left(\frac{x}{2}-\frac{\pi}{12}\right)+C$

(c) $\frac{1}{2}\log\tan\left(\frac{x}{2}+\frac{\pi}{12}\right)+C$

(d) $\frac{1}{2}\log\tan\left(\frac{x}{2}-\frac{\pi}{12}\right)+C$

Space for Rough Work

59. If $\frac{\tan 3\theta - 1}{\tan 3\theta + 1} = \sqrt{3}$, then the general value of θ is

(a) $\frac{n\pi}{3} - \frac{\pi}{12}$ (b) $n\pi + \frac{7\pi}{12}$

(c) $\frac{n\pi}{3} + \frac{7\pi}{36}$ (d) $n\pi + \frac{\pi}{12}$

60. Three normals are drawn to the parabola $y^2 = x$ through point $(a, 0)$. Then

(a) $a = 1/2$

(b) $a = 1/4$

(c) $a > 1/2$

(d) None of these

61. If four vertices of a regular octagon are chosen at random, then the probability that the quadrilateral formed by them is a rectangle is

(a) $\frac{1}{8}$ (b) $\frac{2}{21}$

(c) $\frac{1}{32}$ (d) $\frac{1}{35}$

62. The function $f(x) = x^3 - 3x^2 - 24x + 5$ is an increasing function in the interval given below

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

(b) $(-2, \infty)$

(c) $(-2, 4)$

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

63. If $y = y(x)$ and it follows the relation $x\cos y + y\cos x = \pi$ then $y''(0) =$

(a) 1 (b) -1

(c) π (d) $-\pi$

64. ABC is triangular park with $AB = AC = 100$ m. A clock tower is situated at the mid-point of BC. The angles of elevation of the top of the tower at A and B are $\cot^{-1} 3.2$ and $\text{cosec}^{-1} 2.6$ respectively. The height of the tower is

(a) 50 m

(b) 25 m

(c) 40 m

(d) None of these

65. If the vectors $\overrightarrow{AB} = -3\hat{i} + 4\hat{k}$ and $\overrightarrow{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle ABC, then the length of the median through A is

(a) $\sqrt{14}$ (b) $\sqrt{18}$

(c) $\sqrt{29}$ (d) 4

66. The negation of the compound proposition $p \vee (\sim p \vee q)$ is

(a) $(p \wedge \sim q) \wedge \sim p$

(b) $(p \wedge \sim q) \vee \sim p$

(c) $(p \vee \sim q) \vee \sim p$

(d) None of these

Space for Rough Work

67. Let $f(x)=\begin{cases} x^p \sin\frac{1}{x}, & x \neq 0 \\ 0, & x = 0 \end{cases}$ then $f(x)$ is continuous but not differentiable at $x = 0$ if

(a) $0 < p \leq 1$

(b) $1 \leq p < \infty$

(c) $-\infty < p < 0$

(d) $p = 0$

68. The length and foot of the perpendicular from the point $(7, 14, 5)$ to the plane $2x + 4y - z = 2$, are

(a) $\sqrt{21}, (1,2,8)$

(b) $3\sqrt{21}, (3,2,8)$

(c) $21\sqrt{3}, (1,2,8)$

(d) $3\sqrt{21}, (1,2,8)$

69. If $\Delta(x)=\begin{vmatrix} e^x & \sin x \\ \cos x & \ln(1+x^2) \end{vmatrix}$, then the value of $\lim\limits_{x\to 0}\frac{\Delta(x)}{x}$ is

(a) 0 (b) 2

(c) –1 (d) –2

70. The number of positive integral solutions of the equation $\tan^{-1}x + \cot^{-1}y = \tan^{-1}3$, is

(a) two

(b) one

(c) infinite

(d) None of these

PART-II (Numerical Answer Questions)

71. A box contains two white balls, three black balls and four red balls. The number of ways such that three balls can be drawn from the box if at least one black ball is to be included in the draw is

72. Find the median from the following distribution.

Class	5–10	10–15	15–20	20–25	25–30
frequency	5	6	15	10	5

Class	30–35	35–40	40–45
frequency	4	2	2

73. If α, β are the roots of the equation $2x^2 + 3x + 5 = 0$, then the absolute value of the determinant $\begin{vmatrix} 0 & \beta & \beta \\ \alpha & 0 & \alpha \\ \beta & \alpha & 0 \end{vmatrix}$ is

74. $\int_{-3}^{2} \{|x+1| + |x+2| + |x-1|\}\,dx$ is

75. The area bounded by the curve $y = 2x - x^2$ and the line $y = -x$ is

Space for Rough Work