AIEEE – 2009

Maximum Marks: 315 **Time: 3 hours**

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

INSTRUCTIONS

A. General :

(i) There are three sections in this paper consisting of Physics, Chemistry & Mathematics having 35 questions each.
(ii) For each correct answer 3 marks will be awarded and for each incorrect answer, 1 mark will be deducted.
(iii) Mark only one correct answer out of four alternatives.
(iv) Use Blue/Black Ball Point Pen only for writing particulars/ or any marking.
(v) Use of calculator is not allowed.
(vi) Darken the circles in the space provided only.
(vii) Use of white fluid or any other material which damages the answer sheet, is not permitted.

PHYSICS

1. The displacement x of a particle at any instant is related to its velocity as $v = \sqrt{2x+9}$. Its acceleration and initial velocity are :
(a) 1 unit, 3 unit (b) 2 unit, 9 unit (c) 4 unit, 81 unit (d) 9 unit, 2 unit

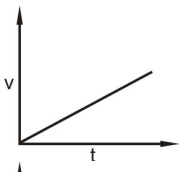
2. A person is walking at the rate of 3 km/hour, the rain appears to fall vertically. When he increase his speed 6 km/hour it appears to meet him at angle of 45° with the vertical. The speed of rain is :
(a) $3\sqrt{2}$ km/hour (b) $\frac{3}{\sqrt{2}}$ km/hour (c) $2\sqrt{6}$ km/hour (d) $2\sqrt{3}$ m/s

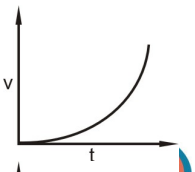
3. A particle moves in a straight line with a uniform acceleration a. Initial velocity of the particle is zero. The average velocity of the particle in first S distance will be :
(a) $\sqrt{aS}$ (b) $\sqrt{\frac{aS}{3}}$ (c) $\sqrt{\frac{aS}{2}}$ (d) $\sqrt{aS}\frac{1}{2}$

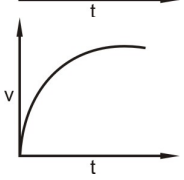
4. A particle is projected vertically upwards and it attains maximum height H. If the ratio of times to attain height h (h < H) is $\frac{1}{3}$, then h equals :
(a) $\frac{2}{3}H$ (b) $\frac{3}{4}H$ (c) $\frac{4}{3}H$ (d) $\frac{3}{2}H$

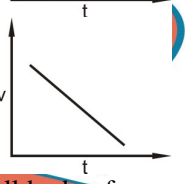
5. Two particles A and B move with constant velocities v_1 and v_2 starting from points with position vectors r_1 and r_2. As they collide at an instant,
(a) $\frac{r_1 - r_2}{|r_1 - r_2|} = \frac{v_1 - v_2}{|v_1 - v_2|}$ (b) $\frac{r_1}{|r_1|} = \frac{v_1}{|v_1|}$ (c) $\frac{r_2}{|r_2|} = \frac{v_1}{|v_1|}$ (d) $\frac{r_2 - r_1}{|r_2 - r_1|} = \frac{v_1 - v_2}{|v_1|}$

6. The velocity of a particle moving in the positive direction of the X-axis varies as $v = K\sqrt{S}$ where K is a positive constant. The graph of velocity v versus time t will be (best) :

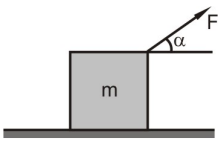
(a) 

(b) 

(c) 

(d) 

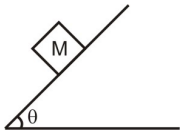
7. At the instant t = 0 a force F = kt (k is a constant) acts on a small body of mass m resting on a smooth horizontal plane. The time, when body leaves the surface is :



(a) $\frac{mg \sin \alpha}{k}$ (b) $\frac{k \sin \alpha}{mg}$

(c) $\frac{mg}{k \sin \alpha}$ (d) mg K sin α

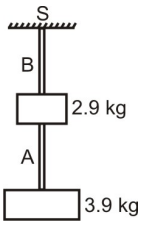
8. The block is in equilibrium. The force exerted by inclined plane on block is



(a) mg cos θ (b) mg sin θ

(c) mg (d) Greater than mg

9. Two blocks of masses 3.9 kg and 2.9 kg are suspended from a rigid support(s) by inextensible string each of length 1 metre. The upper has negligible mass and lower string has uniform mass of 0.2 kg/m. The whole system of blocks, strings and supports have an upward acceleration 0.2 m/s^2. The tension at the mid point of lower string and mid point of upper string is :



(a) $T_A = 30$ N, $T_B = 50$ N (b) $T_A = 50$ N, $T_B = 30$ N

(c) $T_A = 40$ N, $T_B = 35$ N (d) $T_A = 35$ N, $T_B = 40$ N

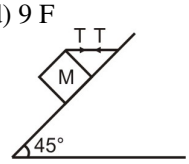
10. A balloon gross weight W newton descends with an acceleration f m/s^2. The weight must be thrown out in order to give the balloon an equal upward acceleration will be :

(a) $\frac{Wf}{g}$ (b) $\frac{2Wf}{g}$ (c) $\frac{2Wf}{g+f}$ (d) $\frac{W(g+f)}{f}$

11. A body is moving with a speed of 1 m/s and a force F is needed to stop it in a distance x. If the speed of body is 3 m/s, the force needed to stop it with the same distance x will be

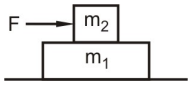
(a) 15 F (b) 3 F (c) 6 F (d) 9 F

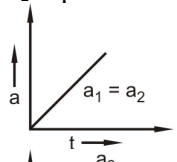
12. A block of mass 10 kg is resting on a rough inclined plane as shown in figure. The block is tied up by a horizontal string which has tension of 25 N. The coefficient of friction between the surfaces of contact is : (g = 10 m/s)

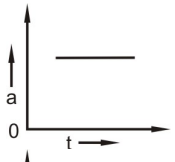


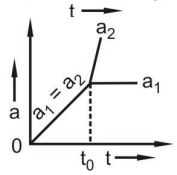
(a) $\frac{1}{2}$ (b) $\frac{3}{5}$ (c) $\frac{3}{4}$ (d) $\frac{1}{4}$

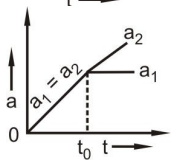
13. Mass m_2 placed on a plank of mass m_1 lying on a smooth horizontal plane. A horizontal force $F = \alpha_o t$ (α_o is a constant) is applied to a bar. If acceleration of the plank and bar are a_1 and a_2 respectively and the coefficient of friction between m_1 and m_2 is μ then acceleration a with time t varies as



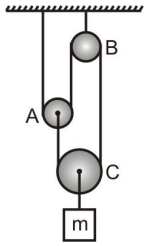
(a) 

(b) 

(c) 

(d) 

14. In the arrangement shown in figure, pulley A and B are massless and the thread is inextensible. All the pulleys are massless. If friction in all the pulleys is negligible, then :



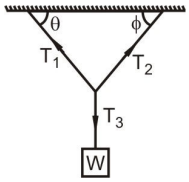
(a) Tension in thread is equal to $\frac{mg}{2}$

(b) Acceleration of pulley C is equal to $\frac{g}{2}$ (downward)

(c) Acceleration of pulley C is equal to $\frac{g}{2}$ (upward)

(d) Acceleration of block of mass m is equal to g (downward)

15. A weight W hangs from a rope that is tied to two other ropes that are fastened to the ceiling as shown in figure making angles θ and ϕ with the horizontal. The values of T_1, T_2 and T_3 are

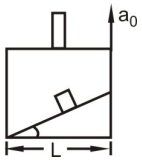


(a) $\frac{W\sin\phi}{\sin(\theta-\phi)}, \frac{W\sin\phi}{\sin(\theta+\phi)}, W\cos\phi$ (b) $\frac{W\sin\phi}{\sin(\theta+\phi)}, \frac{W\sin\phi}{\tan(\theta+\phi)}, W\sin\phi$

(c) $\frac{W\cos\phi}{\sin(\theta+\phi)}, \frac{W\cos\theta}{\sin(\theta+\phi)}, W$ (d) $\frac{W\cos\phi}{\tan(\theta+\phi)}, \frac{W\cos\phi}{\tan(\theta+\phi)}, 2W$

Passage – I (Question 33 to 35) : A particle slides down a smooth inclined plane of elevation θ fixed in an elevator going up with an acceleration a_0. The base of the incline has a length L.

16. The acceleration of particle with respect to the incline :



(a) g sin θ (b) a_0 sin θ

(c) $(g + a_0)$ sin θ (d) (g sin θ + a_0 cos θ)

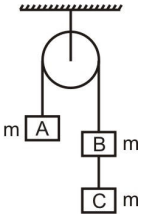
17. The time taken by the particle to reach the bottom :

(a) $t=\left(\frac{2L}{g\sin\theta}\right)^{1/2}$ (b) $\left(\frac{2L}{(g+a_0)\sin\theta\cos\theta}\right)^{\frac{1}{2}}$ (c) $\left(\frac{2L}{a_0\sin\theta}\right)^{1/2}$ (d) $\left(\frac{2L}{(g+a_0)\sin\theta}\right)^{1/2}$

18. If the elevator going up with constant velocity, the time taken by the particle to reach the bottom is :

(a) $\left(\frac{2L}{g\sin\theta\cos\theta}\right)^{1/2}$ (b) $\left(\frac{2L}{g\sin\theta}\right)^{1/2}$ (c) $\left(\frac{2L}{g\cos\theta}\right)^{1/2}$ (d) None of these

19. Three equal weights of mass m each are hanging on a string passing over a fixed pulley. Tension string between B and C :



(a) $\frac{4}{5}$mg (b) $\frac{2}{3}$mg (c) $\frac{1}{3}$mg (d) mg

20. The kinetic energy acquired by a mass m in traveling a certain distance d, starting from rest, under the action of force F such that the force F is directly proportional to t, is

(a) Directly proportional to t^2 (b) Independent of t

(c) Directly proportional to t^4 (d) directly proportional to t

21. A body is acted upon by a force which is inversely proportional to the distance covered. The work done will be proportional to

(a) s (b) s^2 (c) $s^{\frac{1}{2}}$ (d) v^2

22. At what height will a body of mass m thrown vertically up have its kinetic energy 75% of its initial value ?

(a) $\frac{h}{6}$ (b) $\frac{h}{5}$ (c) $\frac{h}{4}$ (d) $\frac{h}{3}$

23. A body, constrained to move in x-direction is subjected to a force $\vec{F} = (-2\hat{i} + 15\hat{j} + 6\hat{k})$N. The work done by this force in moving the body through $10\hat{i}$ is

(a) 20 J (b) 150 J (c) 160 J (d) Zero

24. A particle is displaced to position $(3\hat{i} + 2\hat{j} - 2\hat{k})$ from $(2\hat{i} - \hat{j} + \hat{k})$ under the action of a force $(2\hat{i} + \hat{j} - \hat{k})$ Newton. The work done by the force is

(a) 8 (b) 10 (c) 12 (d) 36

25. If kinetic energy of a body is increased by 300% then percentage change in momentum will be

(a) 100% (b) 150% (c) 265% (d) 73.2%

26. A particle of mass 1 kg is thrown vertically upwards with a speed of 5 m/s. The work done by the force of gravity during the time the particle goes up is

(a) 12.5 J (b) 5 J (c) –5 J (d) –12.5 J

27. The displacement (x) varies with time (t) as $x = 2t^4 + 5$. What is the increase in its kinetic energy one second after the start of motion. Mass of the body is 2 kg.

(a) 8 J (b) 16 J (c) 32 J (d) 64 J

28. A body of mass m is suspended from a massless spring of natural length *l*, stretches the spring through a vertical distance y. The potential energy of the stretched spring is

(a) mg (l + y) (b) $\frac{1}{2}$mg (l + y) (c) $\frac{1}{2}$mgy (d) mgy

29. Force acting on a particle moving in a straight line varies with velocity of the particle as $F = \frac{K}{v}$, where K is a constant. The work done by this force in time t is

(a) $\frac{K}{v^2}t$ (b) 2 Kt (c) Kt (d) $\frac{2Kt}{v^2}$

30. A tennis ball dropped from a height of 5 m rebounds to 2.5 m only on hitting the ground. The fraction of the energy lost in the impact is

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) $\frac{1}{3}$ (d) $\frac{1}{8}$

31. A particle moves in a straight line with retardation proportional to its displacement. The loss of kinetic energy during a displacement x is proportional to

(a) x^2 (b) e^x (c) x (d) $\log_e x$

32. The potential energy of a 1 kg particle free to move along the x-axis is given by $U(x) = \left(\frac{x^4}{4} - \frac{x^2}{2}\right)$J

The total mechanical energy of the particle is 2 J. Then, the maximum speed in (m/s) is

(a) $\frac{1}{\sqrt{2}}$ (b) 2 (c) $\frac{3}{\sqrt{2}}$ (d) $\sqrt{2}$

Passage – II (Question 33 to 35) : A single conservative force F(x) acts on 1 kg particle that moves along x-axis. The potential energy U(x) is given by $U(x) = 20 + (x - 2)^2$ where x is in meters. At x = 5 m the particle has a kinetic energy of 20 J.

33. What is mechanical energy of the system

(a) 29 J (b) 20 J (c) 49 J (d) 19 J

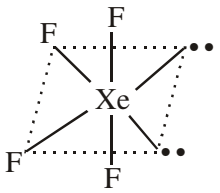
34. The maximum kinetic energy of particle

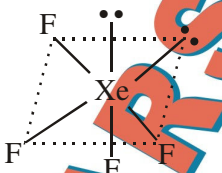
(a) 29 J (b) 20 J (c) 40 J (d) 98 J

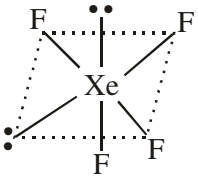
35. Force what (finite) value of x does F(x) = 0

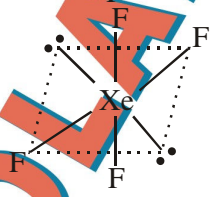
(a) x = 2 m (b) x = 4 m (c) x = 0 m (d) x = 1 m

36. Which is/are the structure of XeF_4 ?

(A) 

(B) 

(C) 

(D) 

37. The correct order of bond angles of the X – N – X bond (where X is the surrounding atom or group of atoms)

(A) $NH_4^+ > N(CH_3)_3 > NH_3 > NF_3$

(B) $NH_4^+ < N(CH_3)_3 < NH_3 < NF_3$

(C) $NH_3 > NF_3 > NH_4^+ > N(CH_3)_3$

(D) $NH_3 > NF_3 > N(CH_3)_3 > NH_4^+$

38. Specify the coordination geometry around and hybridization of N and B atoms in a 1 : 1 complex of BF_3 and NH_3

(A) N : tetrahedral, sp^3, B : tetrahedral, sp^3

(B) N : Pyramidal, sp^3; B : pyramidal, sp^3

(C) N : pyramidal, sp^3, B : planar, sp^2

(D) N : pyramidal, sp^3; B : tetrahedral, sp^3

39. Most efficient overlapping is

(A) $sp^2 – sp^2$

(B) s – s

(C) $sp^3 – sp^3$

(D) sp – sp

40. A number of ionic compounds, e.g. AgCl, CaF_2 and $BaSO_4$ are insoluble in water. This is because

(A) ionic compound do not dissolve in water

(B) water has a high dielectric constant

(C) water is not a good ionizing solvent

(D) these molecules have exceptionally high attractive forces in lattice

41. Solid CH_4 is a

(A) molecular solid

(B) covalent solid

(C) ionic solid

(D) none of these

42. The order of increasing polarity in HCl, CO_2, H_2O and HF molecules is

(A) CO_2, HCl, H_2O, HF

(B) HF, H_2O, HCl, CO_2

(C) CO_2, HCl, HC, H_2O

(D) CO_2, HF, H_2O, HCl

43. Which of the following contain both polar and non-polar bonds?

(A) NH_4Cl

(B) HCN

(C) H_2O_2

(D) CH_4

44. How many σ and π electrons are present in the molecule $(CN)_2 – C = C – (CN)_2$?

(A) 9 sigma and 7 pi electrons

(B) 18 sigma and 14 pi electrons

(C) 9 sigma and 9 pi electrons

(D) 18 sigma and 18 pi electrons

45. Which of the following bonds is the strongest?

(A) F – F

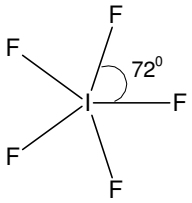
(B) I – I

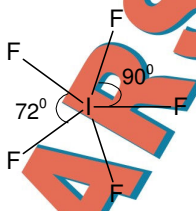
(C) Cl – Cl

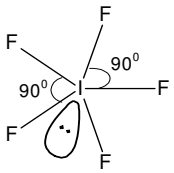
(D) Br – Br

46. Which of the following has highest dipole moment?
(A) NF_3 (B) NH_3
(C) NCl_3 (D) CCl_4

47. The structure of IF_5 can be best described as

(A) 

(B) 

(C) 

(D) None

48. Which of the following structure is most expected for the molecules $XeOF_4$?
(A) Tetrahedral (B) Square pyramidal (C) Square planar (D) Octahedral

49. Which hybrid state can not be shown by carbon atom?
(A) sp^3d (B) sp^3 (C) sp^2 (D) sp

50. If the quantum number *l* could have the value n also then Sc(21) would have electronic configuration as (other rules strictly followed)
(A) $1s^2\ 1p^6\ 2s^2\ 2p^6\ 2d^3\ 3s^2$ (B) $1s^2\ 1p^6\ 2s^2\ 2p^6\ 3s^2\ 3d^1$
(C) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^1\ 4s^2$ (D) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^3$

51. If the radius of first Bohr orbit is x, then de Broglie wavelength of electron in 3rd orbit is nearly
(A) $2\pi x$ (B) $6\pi x$ (C) $9x$ (D) $\frac{x}{3}$

52. If uncertainty in position and velocity are equal then uncertainty in momentum will be
(A) $\frac{1}{2}\sqrt{\frac{mh}{\pi}}$ (B) $\frac{1}{2}\sqrt{\frac{h}{\pi m}}$ (C) $\frac{h}{4\pi m}$ (D) $\frac{mh}{4\pi}$

53. All the four quantum numbers of the last electron in an atom are n = 3, *l* = 1, m = 0, s = 1/2, the atomic number of the element will be
(A) 34 (B) 17 (C) 12 (D) 19

54. The number of waves made by a Bohr electron in an orbit of maximum magnetic quantum number +2 is
(A) 3 (B) 4 (C) 2 (D) 1

55. Which of the following sets of quantum numbers is not allowed?
(A) n = 3, *l* = 1, m = + 2 (B) n = 3, *l* = 1, m = + 1
(C) n = 3, *l* = 0, m = 0 (D) n = 3, *l* = 2, m = ± 2

56. A proton has wavelength 1Å. The potential by which the proton is accelerated will be
(A) 0.0926 V (B) 0.0502 V (C) 0.0826 V (D) 51.2 V

57. An electron is moving with a kinetic energy of 4.55×10^{-25} J. What will be de Broglie wavelength for this electrons?
(A) 5.28×10^{-7} m (B) 7.28×10^{-7} m (C) 2×10^{-10} m (D) 3×10^{-5} m

58. The uncertainty in the location of circulating electron is equal to its de Broglie wavelength. The minimum percentage error in its measurement of velocity under this circumstance will be approximately

(A) 4 (B) 8 (C) 18 (D) 22

59. An electron in energy level n = 1 is given energy E which is slightly more than energy required to excite to level n = 2 and less than energy required to excite to level n = 3. The electron will

(A) be excited to level n = 2 (B) be excited to level n = 3

(C) not be excited (D) be ionized

60. A photon of wavelength 300 nm is absorbed by a gas and then reemitted as two photons. One photon is red with wavelength of 760 nm. The wave number of the second photon will be

(A) $2.02 \times 10^6\ m^{-1}$ (B) $3.02 \times 10^6\ m^{-1}$ (C) $1.02 \times 10^6 m^{-1}$ (D) $2.2 \times 10^6 m^{-1}$

61. Energy levels of A, B, C of a certain atom correspond to increasing values of energy i.e. $E_A < E_B < E_C$. If $\lambda_1, \lambda_2, \lambda_3$ are the wavelengths from C to B, B to A, C to A respectively which of the following relation is correct?

(A) $\lambda_3 = \lambda_1 + \lambda_2$ (B) $\lambda_3 = \dfrac{\lambda_1\lambda_2}{(\lambda_1 + \lambda_2)}$ (C) $\lambda_1 + \lambda_2 + \lambda_3 = 0$ (D) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$

62. An electron of velocity 'v' is found to have a certain value of de Broglie wavelength. The velocity to be possessed by the neutron to have same wavelength is

(A) 1840 v (B) v/1840 (C) v (D) 1840/v

63. The de Broglie equation describes the relationship of wavelength associated with the motion of an electron and

(A) position of electron (B) mass of electron only

(C) velocity and mass of electron (D) distance from the nucleus

64. For which one of the following sets of quantum numbers, an electron will have the highest energy?

(A) n = 3, *l* = 2, m = 1, s = + 1/2 (B) n = 4, *l* = 2, m = - 1, s = + 1/2

(C) n = 4, *l* = 1, m = 0, s = - 1/2 (D) n = 5, *l* = 0, m = 0, s = - 1/2

65. Spin of electron is

(A) rotation of electron about it's own axis

(B) clockwise and anticlockwise rotation of electron

(C) a quantum number which depends upon direction and speed of rotation of electron

(D) an intrinsic characteristic of electron connected with its magnetic field

66. According to Schrodinger model nature of electron in an atom is as

(A) particles only (B) wave only

(C) both simultaneously (D) sometimes wave and sometimes particle

67. The equivalent mass of $MnSO_4$ is half of its molar mass when it is converted to

(A) Mn_2O_3 (B) MnO_2 (C) MnO_4^- (D) MnO_4^{2-}

68. 0.3 g of a sample of an oxalate salt is dissolved in 100 cc of water. It required 90 cc of N/20 $KMnO_4$ solution for complete oxidation. The percentage of oxalate ($C_2O_4^{2-}$) in the given sample is

(A) 66 (B) 33 (C) 68 (D) 64

69. Two acids (X) and (Y) are titrated separately each time with 25 ml of 1 N Na_2CO_3 solution and required 10 ml and 40 ml respectively for complete neutralization. The volumes of acids (X) and (Y) require to mix to produce one liter of 1 N acid solution are respectively,

(A) 200 ml of (X) and 800 ml of (Y) (B) 800 ml of (X) and 200 ml of (Y)

(C) 400 ml of (X) and 400 ml of (Y) (D) 600 ml of (X) and 400 ml of (Y)

70. The molality of 15% (wt./vol.) solution of H_2SO_4 of density 1.1 g/cm^3 is approximately

(A) 1.2 (B) 1.4 (C) 1.8 (D) 1.6

71. If $x > 1$, the least value of $2\log_{100} x^2 - \log_x 0.01$ is

(A) 2 (B) 4 (C) 1 (D) 0

72. If the domain of definition of f(x) is the open interval (0, 1), the domain of definition of f(*l*n x) + f(cos x) is

(A) (0, e) (B) $\left(1, \frac{\pi}{2}\right)$ (C) $\left(-\infty, \frac{\pi}{2}\right)$ (D) none of these

73. For what value of 'a' the equation $||x|-1| = a$ has four solutions

(A) $0 \le a \le 1$ (B) $0 < a < 1$ (C) $a > 1$ (D) $a \ge 1$

74. If $f : (4, 8) \to (5, 9)$ is a function defined by $f(x) = x + \left[\frac{x}{4}\right]$ where [·] stands for greatest integer function then $f^{-1}(x)$

(A) does not exist (B) is 1 + x (C) is 1 – x (D) is x – 1

75. If $f : R \to R$ and $f(x) = ax + \sin x + a$, then f(x) is one–one onto function if

(A) $a \in R$ (B) $a \in R - [-1, 1]$ (C) $a \in R - \{0\}$ (D) $a \in R - \{-1, 1\}$

76. $f(x) = x^a + \sin x - ax$ $(x > 0)$ is periodic function for

(A) one value of 'a' (B) two value of 'a' (C) infinite value of 'a' (D) no value of 'a'

77. If $f(x) = \min\{x, x^3\}$, then

(A) f is discontinuous at 2 points only (B) f is not differentiable at 2 points only

(C) $f'(x) = 1 \forall x \in (-1, 0) \cup (1, \infty)$ (D) f is odd

78. The function $f(x) = \frac{|x| - x\left(3^{1/x} + 1\right)}{3^{1/x} - 1}; x \ne 0$ $f(0) = 0$ is

(A) discontinuous at x = 0

(B) continuous at x = 0 but not differentiable there

(C) both continuous & differentiable at x = 0

(D) differentiable but not continuous at x = 0

79. Number of points of discontinuity of the function $f(x) = \underset{n\to\infty}{\text{Lt}} \frac{2\sin x}{3^n + (2\cos x)^{2n}}$ are given by

(A) 0 (B) 1 (C) infinite (D) none of these

80. If $a\, f(x + 1) + b\, f\left(\frac{1}{x+1}\right) = x$, $x \ne -1$, then f(x) is equal to

(A) $\frac{2a + b}{2\left(a^2 - b^2\right)}$ (B) $\frac{a}{a^2 - b^2}$ (C) $\frac{a + 2b}{\left(a^2 - b^2\right)}$ (D) $\frac{b}{a^2 - b^2}$

81. If $f(x) = \underset{n\to\infty}{\text{Lt}}\, n\left(x^{1/n} - 1\right)$, then for x > 0, y > 0, f(xy) is equal to

(A) f(x). f(y) (B) f(x) + f(y) (C) f(x) – f(y) (D) none of these

82. The value of $\lim_{x\to 3} \frac{\frac{1}{\sqrt{18 - x^2}} - \frac{1}{3}}{x - 3}$, is

(A) $\frac{1}{9}$ (B) – 3 (C) – 9 (D) $\frac{1}{3}$

83. If $\lim_{x\to 0} \frac{a + e^{1/x}}{1 + be^{1/x}} = 2$, then the value of a and b, are

(A) $a \in \mathbf{R}$, $b \in \mathbf{R}$ (B) $a = 2, b \in \mathbf{R}$ (C) $a \in \mathbf{R}$, $b = 1/2$ (D) none of these

84. The value of $\lim\limits_{x\to 0}\dfrac{x\sqrt{(x+y)^2-y^2}}{\left(\sqrt{8xy+x^2}+\sqrt{8xy-x^2}\right)^3}$, is

(A) $4\sqrt{2}\,y$ (B) $2\sqrt{2}\,y$ (C) $\dfrac{1}{8\sqrt{2}y}$ (D) none of these

85. The value of $\lim\limits_{x\to 0^+}\dfrac{2^{\sqrt{x}}-2^{1/\sqrt{x}}}{2^{\sqrt{x}}+2^{1/\sqrt{x}}}$, is

(A) 1 (B) 0 (C) – 1 (D) dne

86. If $\lim\limits_{x\to\infty}\dfrac{x^a\,|\sin x|}{x^2-1}$ exists, then the value of a, is

(A) $0 < a < 1$ (B) $a < 2$ (C) $a > 1$ (D) $a \in \mathbf{R}$

87. The value of $\lim\limits_{x\to 1}(1-x)\tan\left(\dfrac{\pi x}{2}\right)$, is

(A) 0 (B) – 1 (C) 1 (D) none of these

88. The value of $\lim\limits_{x\to 0}(2-\cos x)^{\frac{1}{\ln(\cos x)}}$, is

(A) ln 2 (B) e (C) e^{-1} (D) none of these

89. If $\lim\limits_{x\to\infty}\left(1+\dfrac{a}{x}+\dfrac{b}{x^2}\right)^{2x}=e^2$, then the value of a and b, are

(A) $a \in \mathbf{R}$, $b \in \mathbf{R}$ (B) $a = 1$, $b \in \mathbf{R}$ (C) $a \in \mathbf{R}$, $b = 2$ (D) none of these

90. The value of $\lim\limits_{x\to\infty}\left(\dfrac{n!}{(mn)^n}\right)^{1/n}$, is

(A) em (B) $\dfrac{e}{m}$ (C) $\dfrac{1}{em}$ (D) none of these

91. If $\lim\limits_{n\to\infty}\left(an+\dfrac{n^2+2}{n-2}\right)=b$, then the values of a and b, are

(A) $a \in \mathbf{R}$, $b = 2$ (B) $a = -1$, $b \in \mathbf{R}$ (C) $a \in \mathbf{R}$, $b \in \mathbf{R}$ (D) $a = -1$, $b = 2$

92. The value of $\lim\limits_{x\to 1^+}\dfrac{x\sin\{x\}}{x-1}$ where $\{\cdot\}$ denotes fractional part, is

(A) 0 (B) – 1 (C) 1 (D) do not exist

93. The value of $\lim\limits_{x\to\infty}\dfrac{\ln[x]}{x}$ where $[\cdot]$ denotes integral part, is

(A) – 1 (B) 0 (C) 1 (D) do not exist

94. The value of $\lim\limits_{x\to 2}\dfrac{\sin\left(e^{x-2}-1\right)}{\ln(x-1)}$, is

(A) – 2 (B) 1 (C) – 1 (D) 0

95. Let $f(x)=\dfrac{(128a+ax)^{1/8}-2}{(32+bx)^{1/5}-2}$. If f is continuous at x = a, then the value of $\dfrac{a}{b}$, is

(A) $\dfrac{8}{5}f(0)$ (B) $2^{8/5}f(0)$ (C) $2^{5/8}$ (D) none of these

96. Let $f''(x)$ be continuous at x = 0, $f(0) \neq 0$ and $\lim\limits_{x\to 0}\dfrac{2f(x)-3af(2x)+b\,f(8x)}{\sin^2 x}$ exists, then the values of a and b, are

(A) $a = b = 1$ (B) $a = 1$, $b = -1$ (C) $a = b = -1$ (D) $a = -1$, $b = 1$

97. Let $f(x) = bx^2 - a, \quad x < -1$
$= ax^2 - bx - 2, \quad x \geq -1.$
If $f'(x)$ is continuous everywhere, then
(A) $a = \pm 1, b = -3$ (B) $a = 1, b = 2$ (C) $a = 2, b = 3$ (D) $a = -1, b = -3$

98. Let f and g be two continuous and differentiable functions satisfying $f(x + y) = f(x) + f(y)$ for all x and y and $f(x) = x^2 g(x)$, then f(x) is equal to
(A) $g'(x)$ (B) $g(0)$ (C) 0 (D) x

99. Let $f(x) = [\sin^2 x], x \in [-\pi, \pi]$. Then the function is
(A) discontinuous at 4 points (B) non–differentiable at 4 points
(C) continuous everywhere (D) non–differentiable at 2 points

100. Let $f(x) = x[1 + \sin(\ln x^2)]$, where $[\cdot]$ denotes integral part. Then the function
(A) is continuous at x = 0 (B) has a removable discontinuity at x = 0
(C) has an irremovable discontinuity at x = 0 (D) is differentiable at x = 0

101. Let f(x) and g(x) be defined and differentiable for $x \geq x_0$. If $f(x_0) = g(x_0)$ and $f'(x) > g'(x)$ for $x > x_0$, then
(A) $f(x) < g(x)$ for every $x > x_0$ (B) $f(x) = g(x0$ for some $x > x_0$
(C) $f(x) > g(x)$ for every $x > x_0$ (D) none of these

102. If $|y| = 2x + 3y$, then the wrong statements are
(A) y(x) is strictly decreasing $\forall x \in \mathbf{R}$ (B) domain of y(x) is $x \in \mathbf{R}$
(C) y(x) is continuous at differentiable $\forall x \in \mathbf{R}$ (D) none of these

103. If $f(x) = \dfrac{x \ln(1+\sin x)}{\ln(1+\sin^2 x)}, \quad x \neq 0$
$= 0, \quad x = 0$
Then the function
(A) has an irremovable discontinuity at x = 0
(B) has a removable discontinuity at x = 0
(C) is continuous but not differentiable at x = 0
(D) is differentiable at x = 0

104. Let $f(x) = \dfrac{a|x^2 - 3x + 2|}{3x - 2 - x^2}, \quad x < 1$
$= b, \quad x = 1$
$= \dfrac{\{x\}}{\sin(x-1)}, \quad x > 1$
If f is continuous everywhere, then
(A) $a = -1, b = 1$ (B) $a = 1, b = 1$ (C) $a = -2, b = 1$ (D) $a = 2, b = -2$

105. The function $f(x) = (x^2 - 1)\left|x^2 - 3x + 2\right| + \cos|x|$ is not differentiable at
(A) x = 0, 1 (B) x = – 1, 1 (C) x = 1 (D) none of these