AIEEE 2004 Question Paper

PHYSICS & CHEMISTRY (PART - I)

1. Which one of the following represents the correct dimensions of the coefficient of viscosity?
(a) $[ML^{-1}T^{-2}]$ (b) $[MLT^{-1}]$ (c) $[ML^{-1}T^{-1}]$ (d) $[ML^{-2}T^{-2}]$

2. A particle moves in a straight line with retardation proportional to its displacement. Its loss of kinetic energy for any displacement x is proportional to:
(a) x^2 (b) e^x (c) x (d) $\log_e x$

3. A ball is released from the top of a tower of height h metres. It takes T seconds to reach the ground. What is the position of the ball in T/3 seconds?
(a) h/9 metre from the ground (b) 7h/9 metre from the ground
(c) 8h/9 metre from the ground (d) 17h/18 metre from the ground

4. If $\vec{A}\times\vec{B}=\vec{B}\times\vec{A}$, then the angle between A and B is:
(a) π (b) $\pi/3$ (c) $\pi/2$ (d) $\pi/4$

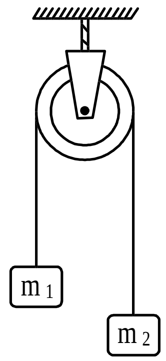
5. A projecile can have the same range R for two angles of projection. If T_1 and T_2 be the time of flights in the two cases, then the product of the two times of flights is directly proportional to:
(a) $1/R^2$ (b) 1/R (c) R (d) R^2

6. Which of the following statements is false for a particle moving in a circle with a constant angular speed?
(a) The velocity vector is tangent to the circle
(b) The acceleration vector is tangent to the circle
(c) The acceleration vector points to the centre of the circle
(d) The velocity and acceleration vectors are perpendicular to each other

7. An automobile travelling with a speed of 60 km/h, can brake to stop within a distance of 20 m. If the car is going twice as fast, i.e. 120 km/h, the stopping distance will be:
(a) 20 m (b) 40 m (c) 60 m (d) 80 m

8. A machine gun fires a bullet of mass 40 g with a velocity 1200 ms^{-1}. The man holding it, can exert a maximum force of 144 N on the gun. How many bullets can he fire per second at the most?
(a) One (b) Four (c) Two (d) Three

9. Two masses m_1 = 5 kg and m_2 = 4.8 kg tied to a string are hanging over a light frictionless pulley. What is the acceleration of the masses when lift is free to move? (g = 9.8 m/s^2)
(a) 0.2 m/s^2
(b) 9.8 m/s^2
(c) 5 m/s^2
(d) 4.8 m/s^2



10. A uniform chain of length 2 m is kept on a table such that a length of 60 cm hangs freely from the edge of the table. The total mass of the chain is 4 kg. What is the work done in pulling the entire chain on the table?
(a) 7.2 J (b) 3.6 J (c) 120 J (d) 1200 J

11. A block rests on a rough inclined plane making an angle of 30^0 with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictional force on the block is 10 N, the mass of the block (in kg) is (take g = 10 m/s^2):
(a) 2.0 (b) 4.0 (c) 1.6 (d) 2.5

12. A force $\vec{F}=(5\hat{i}+3\hat{j}+2\hat{k})$ N is applied over a particle which displaces it from its origin to the point

$\vec{r} = (2\hat{i} - \hat{j})$ m. The work done on the particle in joules is:

(a) -7 (b) +7 (C) +10 (d) +13

13. A body of mass m accelerates uniformly from rest to v_1 in time t_1. The instantaneous power delivered to the body as a function of time t is:

(a) $\frac{mv_1t}{t_1}$ (b) $\frac{mv_1^2t}{t_1^2}$ (c) $\frac{mv_1t^2}{t_1}$ (d) $\frac{mv_1^2t}{t_1}$

14. A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle. The motion of the particle takes place in a plane, it follows that:

(a) its velocity is constant (b) its acceleration is constant
(c) its kinetic energy is constant (d) it moves in a straight line

15. A solid sphere is rotating in free space. If the radius of the sphere is increased keeping mass same which one of the following will not be affected?

(a) Moment of inertia (b) Angular momentum (c) Angular velocity (d) Rotational kinetic energy

16. A ball is thrown from a point with a speed v_0 at an angle of projection θ. From the same point and at the same instant, a person starts running with a constant speed $v_0/2$ to catch the ball. Will the person be able to catch the ball? If yes, what should be the angle of projection?

(a) Yes, 60^0 (b) Yes, 30^0 (c) No (d) Yes, 45^0

17. One solid sphere A and another hollow sphere B are of same mass and same outer radii. Their moment of inertia about their diameters are respectively I_A and I_B such that:

(a) $I_A = I_B$ (b) $I_A > I_B$ (c) $I_A < I_B$ (d) $I_A/I_B = d_A/d_B$
where d_A and d_B are their densities.

18. A satellite of mass m revolves around the earth of radius R at a height *x* from its surface. If g is the acceleration due to gravity on the surface of the earth, the orbital speed of the satellite is:

(a) gx (b) $\frac{gR}{R-x}$ (c) $\frac{gR^2}{R+x}$ (d) $\left(\frac{gR^2}{R+x}\right)^{1/2}$

19. The time period of an earth satellite in circular orbit is independent of:

(a) the mass of the satellite (b) radius of its orbit
(c) both the mass and radius of the orbit
(d) neither the mass of the satellite nor the radius of its orbit

20. If *g* is the acceleration due to gravity on the earth's surface, the gain in the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth, is:

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

21. Suppose the gravitational force varies inversely as the n^{th} power of distance. Then the time period of a planet in circular orbit of radius R around the sun will be proportional to:

(a) $R^{\left(\frac{n+1}{2}\right)}$ (b) $R^{\left(\frac{n-1}{2}\right)}$ (c) R_n (d) $R^{\left(\frac{n-2}{2}\right)}$

22. A wire fixed at the upper end stretches by length *l* by applying a force F. The work done in stretching is:

(a) F/2*l* (b) F*l* (c) 2F*l* (d) F*l*/2

23. Spherical balls of radius R are falling in a viscous fluid of viscosity η with a velocity v. The retarding viscous force acting on the spherical ball is:

(a) directly proportional to R but inversely proportional to v

(b) directly proportional to both radius R and velocity v
(c) inversely proportional to both radius R and velocity v
(d) inversely proportional to R but directly proportional to velocity v

24. If two soap bubbles of different radii are connected by a tube:
(a) air flows from the bigger bubble to the smaller bubble till the sizes become equal
(b) air flows from bigger bubble to the smaller bubble till the sizes are interchanged
(c) air flows from the smaller bubble to the bigger
(d) there is no flow of air

25. The bob of a simple pendulum executes simple harmonic motion in water with a period t, while the period of oscillation of the bob is t_0 in air. Neglecting frictional force of water and given that the density of the bob is $(4/3)\times 1000$ kg/m^3. What relationship between t and t_0 is true?
(a) $t = t_0$ (b) $t = t_0/2$ (C) $t = 2t_0$ (d) $t = 4t_0$

26. A particle at the end of a spring executes simple harmonic motion with a period t_1, while the corresponding period for another spring is t_2. If the period of oscillation with the two springs in series is T, then:
(a) $T = t_1 + t_2$ (b) $T^2 = t^2_1 + t^2_2$ (c) $T^{-1} = t^{-1}_1 + t^{-1}_2$ (d) $T^{-2} = t^{-2}_1 + t^{-2}_2$

27. The total energy of a particle, executing simple harmonic motion is:
(a) $\propto x$ (b) $\propto x^2$ (c) independent of x (d) $\propto x^{1/2}$
where x is the displacement from the mean position.

28. The displacement y of a particle in a medium can be expressed as:
$y = 10^{-6}\sin(100t + 20x + \frac{\pi}{4})\,m$, where t is in second and x in metre. The speed of the wave is:
(a) 2000 m/s (b) 5 m/s (c) 20 m/s (d) $5\pi\ m/s$

29. A particle of mass m is attached to a spring (of spring constant k) and has a natural angular frequency ω_0. An external force F(t) proportional to $\cos\omega t\ (\omega \neq \omega_0)$ is applied to the oscillator. The time displacement of the oscillator will be proportional to:
(a) $\frac{m}{\omega_0^2 - \omega^2}$ (b) $\frac{m}{m(\omega_0^2 - \omega^2)}$ (c) $\frac{1}{m(\omega_0^2 + \omega^2)}$ (d) $\frac{m}{\omega_0^2 + \omega^2}$

30. In forced oscillation of a particle, the amplitude is maximum for a frequency ω_1 of the force while the energy is maximum for a frequency ω_2 of the force, then:
(a) $\omega_1 = \omega_2$ (b) $\omega_1 > \omega_2$
(c) $\omega_1 < \omega_2$ when damping is small and $\omega_1 > \omega_2$ when damping is large (d) $\omega_1 < \omega_2$

31. One mole of ideal monoatomic gas (v = 5/3) is mixed with one mole of diatomic gas $((\gamma = 7/5)$. What is γ for the mixture? γ denotes the ratio of specific heat at constant pressure, to that at constant volume.
(a) 3/2 (b) 23/15 (C) 35/23 (d) 4/3

32. If the temperature of the sum were to increase from T to 2T and its radius from R to 2R, then the ratio of the radiant energy received on earth to what it was previously, will be:
(a) 4 (b) 16 (c) 32 (d) 64

33. Which of the following statements is correct for any thermodynamic system?
(a) The internal energy changes in all processes
(b) Internal energy and entropy are state functions
(c) The change in entropy can never be zero

(d) The work done in an adiabatic process is always zero

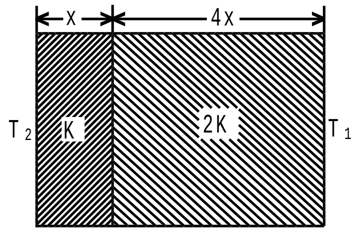
34. Two thermally insulated vessels 1 and 2 are filled with air at temperature (T_1, T_2), volume (V_1, V_2) and pressure (P_1, P_2) respectively. If the valve joining the two vessels is opened, the temperature inside the vessel at equilibrium will be:

(a) $T_1 + T_2$ (b) $(T_1 + T_2)/2$ (c) $\dfrac{T_1T_2(P_1V_1+P_2V_2)}{P_1V_1T_2+P_2V_2T_1}$ (d) $\dfrac{T_1T_2(P_1V_1+P_2V_2)}{P_1V_1T_1+P_2V_2T_2}$

35. A radiation of energy E falls normally on a perfectly reflecting surface. The momentum transferred to the surface is:

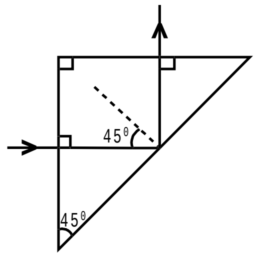
(a) E/c (b) 2E/c (c) Ec (d) E/c^2

36. The temperature of the two outer surfaces of a composite slab, consisting of two materials having coefficients of thermal conductivity K and 2K and thickness x and 4x, respectively are T_2 and T_1 ($T_2 > T_1$). The rate of heat transfer through the slab, in a steady state is $\left(\dfrac{A(T_2-T_1)K}{x}\right)f$, with f equals to:



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

37. A light ray is incident perpendicular to one face of a 90^0 prism and is totally internally reflected at the glass-air interface. If the angle of reflection is 45^0, we conclude that the refractive index n:



(a) $n<\dfrac{1}{\sqrt{2}}$ (b) $n>\sqrt{2}$ (c) $n>\dfrac{1}{\sqrt{2}}$ (d) $n<\sqrt{2}$

38. A plano-convex of refractive index 1.5 and radius of curvature 30 cm is silvered at the curved surface. Now this lens has been used to form the image of an object. At what distance from this lens, an object be placed in order to have a real image of the size of the object?

(a) 20 cm (b) 30 cm (c) 60 cm (d) 80 cm

39. The angle of incidence at which reflected light is totally polarized for reflection from air to glass (refractive index n), is:

(a) $\sin^{-1}(n)$ (b) $\sin^{-1}(1/n)$ (c) $\tan^{-1}(1/n)$ (d) $\tan^{-1}(n)$

40. The maximum number of possible interference maxima for slit-separation equal to twice the wavelength in Young's double-slit experiment, is;

(a) infinite (b) five (c) three (d) zero

41. An electromagnetic wave of frequency v = 3.0 MHz passes from vacuum into a dielectric medium with permittivity $\varepsilon = 4.0$. Then:

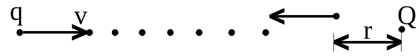
(a) wavelength is doubled and frequency remains unchanged
(b) wavelength is doubled and frequency becomes half
(c) wavelength is halved and frequency remains unchanged
(d) wavelength and frequency both remain unchanged

42. Two spherical conductors B and C having equal radii and carrying equal charges in them repel each other with a force F when kept apart at some distance. A third spherical conductor having same radius as that of B but uncharged, is brought in contact with B, then brought in contact with C and finally removed away from both. The new force of repulsion between B and C is:

(a) $\dfrac{F}{4}$ (b) $\dfrac{3F}{4}$ (c) $\dfrac{F}{8}$ (d) $\dfrac{3F}{8}$

43. A charged particle q is shot towards another charged particle Q which is fixed, with a speed v. It approaches Q upto a closest distance r and then returns. If q was given a speed 2v, the closest

distance of approach would be:

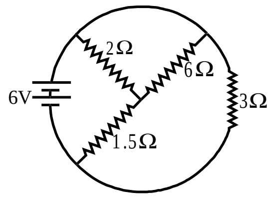


(a) r (b) 2r (c) r/2 (d) r/4

44. Four charges equal to -Q are placed at the four corners of a square and a charge q is at its centre. If the system is in equilibrium, the value of q is:

(a) $-\frac{Q}{4}(1+2\sqrt{2})$ (b) $\frac{Q}{4}(1+2\sqrt{2})$ (c) $-\frac{Q}{2}(1+2\sqrt{2})$ (d) $\frac{Q}{2}(1+2\sqrt{2})$

45. Alternating current can not be measured by D.C. ammeter because:
(a) A.C. cannot pass through D.C. ammeter
(b) A.C changes direction
(c) Average value of current for complete cycle is zero
(d) D.C. ammeter will get damaged



46. The total current supplied to the circuit by the battery is:
(a) 1 A (b) 2 A (c) 4 A (d) 6 A

47. The resistance of the series combination of two resistances is S. When they are joined in parallel, the total resistance is P. If S = *n*P, then the minimum possible value of *n* is:
(a) 4 (b) 3 (c) 2 (d) 1

48. An electric current is passed through a circuit containing two wires of the same material, connected in parallel. If the lengths and radii of the wires are in the ratio of 4/3 and 2/3, then the ratio of the currents passing through the wire will be:
(a) 3 (b) 1/3 (c) 8/9 (d) 2

49. In a metre bridge experiment, null point is obtaining at 20 cm from one end of the wire when resistance X is balanced against another resistance Y. If X < Y, then where will be the new position of the null point from the same end, if one decides to balance a resistance of 4X against Y?
(a) 50 cm (b) 80 cm (c) 40 cm (d) 70 cm

50. The thermistors are usually made of:
(a) metals with low temperature coefficient of resistivity
(b) metals with high temperature coefficient of resistivity
(c) metal oxides with high temperature coefficient of resistivity
(d) semiconducting materials having low temperature coefficient of resistivity

51. Time taken by a 836 W heater to heat one litre of water from 10^0C to 40^0C is:
(a) 50 s (b) 100 s (c) 150 s (d) 200 s

52. The thermo-emf of a thermocouple varies with the temperature θ of the hot junction as E = aθ + bθ^2 in volts where the ratio a/b is 700^0C. If the cold junction is kept at 0^0C, then the neutral temperature is:
(a) 700^0C (b) 350^0C
(c) 1400^0C (d) no neutral temperature is possible for this thermocouple

53. The electrochemical equivalent of metal is 3.3×10^{-7} kg per coulomb. The mass of the metal liberated at the cathode when a 3 A current is passed for 2 seconds, will be:
(a) 19.8×10^{-7} kg (b) 9.9×10^{-7} kg (c) 6.6×10^{-7} kg (d) 1.1×10^{-7} kg

54. A current *i* ampere flows along an infinitely long straight thin walled tube, then the magnetic induction at any point inside the tube is:

(a) infinite (b) zero (c) $\frac{\mu_0}{4\pi}.\frac{2i}{r}$ tesla (d) $\frac{2i}{r}$ tesla

55. A long wire carries a steady current. It is bent into a circle of one turn and the magnetic field at the centre of the coil is B. It is then bent into a circular loop of *n* turns. The magnetic field at the centre

of the coil will be:

(a) nB (b) n^2B (c) 2nB (d) $2n^2B$

56. The magnetic field due to a current carrying circular loop of radius 3 cm at a point on the axis at a distance of 4 cm from the centre is 54 μT. What will be its value at the centre of the loop?

(a) 250 μT (b) 150 μT (c) 125 μT (d) 75 μT

57. Two long conductors, separated by a distance d carry currents I_1 and I_2 in the same direction. They exert a force F on each other. Now the current in one of them is increased to two times and its direction is reversed. The distance is also increased to 3d. The new value of the force between them is:

(a) -2F (b) F/3 (c) -2F/3 (d) -F/3

58. The length of a magnet is large compared to its width and breadth. The time period of its oscillation in a vibration magnetometer is 2s. The magnet is cut along its length into three equal parts and three parts are then placed on each other with their like poles together. The time period of this combination will be:

(a) 2 s (b) 2/3 s (c) $2\sqrt{3}$ s (d) $2/\sqrt{3}$ s

59. The materials suitable for making electromagnets should have:

(a) high retentivity and high coercivity (b) low retentivity and low coercivity

(c) high retentivity and low coercivity (d) low retentivity and high coercivity

60. In an LCR series a.c. circuit, the voltage across each of the components. L, C and R is 50 V. The voltage across the LC combination will be;

(a) 50 V (b) $50\sqrt{2}$ V (C) 100 V (d) 0 V (zero)

61. A coil having *n* turns and resistance RΩ is connected with a galvanometer of resistance 4RΩ. This combination is moved in time t seconds from a magnetic field W_1 weber to W_2 weber. The induced current in the circuit is:

(a) $\frac{W_2 - W_1}{5Rnt}$ (b) $-\frac{n(W_2 - W_1)}{5Rt}$ (c) $-\frac{(W_2 - W_1)}{Rnt}$ (d) $-\frac{n(W_2 - W_1)}{Rt}$

62. In a uniform magnetic field of induction B, a wire in the form of semicircle of radius r rotates about the diameter of the circle with angular frequency ω. If the total resistance of the circuit is R, the mean power generated per period of rotation is:

(a) $\frac{B\pi r^2\omega}{2R}$ (b) $\frac{(B\pi r^2\omega)^2}{8R}$ (c) $\frac{(B\pi r\omega)^2}{2R}$ (d) $\frac{(B\pi r\omega^2)^2}{8R}$

63. In an LCR circuit, capacitance is changed from C to 2C. For the resonant frequency to remain unchanged, the inductance should be changed from L to :

(a) 4L (b) 2L (c) L/2 (d) L/4

64. A metal conductor of length 1 m rotates vertically about one of its ends at angular velocity 5 radians per second. If the horizontal component of earth's magnetic field is 0.2×10^{-4} T, then the emf developed between the two ends of the conductor is:

(a) 5μV (b) 50μV (c) 5 mV (d) 50 mV

65. According to Einstein's photoelectric equation, the plot of the kinetic energy of the emitted photoelectrons from a metal Vs the frequency, of the incident radiation gives a straight line whose slope:

(a) depends on the nature of the metal used (b) depends on the intensity of the radiation

(c) depends both on the intensity of the radiation and the metal used

(d) is the same for all metals and independent of the intensity of the radiation

66. The work function of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately:

(a) 540 nm (b) 400 nm (c) 310 nm (d) 220 nm

67. A charged oil drop is suspended in uniform field of 3×10^4 V/m so that it neither falls nor rises. The charge on the drop will be: (take the mass of the charge = 9.9×10^{-15} kg and g = 10 m/s^2)
(a) 3.3×10^{-18} C (b) 3.2×10^{-18} C (c) 1.6×10^{-18} C (d) 4.8×10^{-18} C

68. A nucleus disintegrates into two nuclear parts which have their velocities in the ratio 2 : 1. The ratio of their nuclear sizes will be:
(a) $2^{1/3}$: 1 (b) 1 : $3^{1/2}$ (c) $3^{1/2}$: 1 (d) 1 : $2^{1/3}$

69. The binding energy per nucleon of deuteron $\left({}_1^2\text{H}\right)$ and helium nucleus $\left({}_2^4\text{He}\right)$ is 1.1 MeV and 7 MeV respectively. If two deuteron nuclei reacts to form a single helium nucleus, then the energy released is:
(a) 13.9 MeV (b) 26.9 MeV (c) 23.6 MeV (d) 19.2 MeV

70. An α- particle of energy 5 MeV is scattered through 180^0 by a fixed uranium nucleus. The distance of the closest approach is of the order of:
(a) 1 Å (b) 10^{-10} cm (c) 10^{-12} cm (d) 10^{-15} cm

71. When *npn* transistor is used as an amplifier:
(a) electrons move from base to collector (b) holes move from emitter to base
(c) electrons move from collector to base (d) holes move from base to emitter

72. For a transistor amplifier in common emitter configuration for load impedance of $1\,\text{k}\Omega$ (h_{fe} = 50 and h_{oe} = $25\,\mu$A/V), the current gain is:
(a) -5.2 (b) -15.7 (c) -24.8 (d) -48.78

73. A piece of copper and another of germanium are cooled from room temperature to 77 K, the resistance of :
(a) each of them increases (b) each of them decreases
(c) copper decreases and germanium increases (d) copper increases and germanium decreases

74. The manifestation of band structure in solids is due to;
(a) Heisenberg's uncertainty principle (b) Pauli's exclusion principle
(c) Bohr's correspondence principle (d) Boltzmann's law

75. When *p-n* junction diode is forward biased, then:
(a) the depletion region is reduced and barrier height is increased
(b) the depletion region is widened and barrier height is reduced
(c) both the depletion region and barrier height are reduced
(d) both the depletion region and barrier height are increased

76. Which of the following sets of quantum numbers is correct for an electron in 4*f* orbital?
(a) n = 4, l = 3, m = +4, s = +1/2 (b) n = 4, l = 4, m = -4, s = -1/2
(c) n = 4, l = 3, m = +1, s = +1/2 (d) n = 3, l = 2, m = -2, s = +1/2

77. Consider the ground state of Cr atom (Z = 24). The numbers of electrons with the azimuthal quantum numbers, *l* = 1 and 2 are, respectively:
(a) 12 and 4 (b) 12 and 5 (c) 16 and 4 (d) 16 and 5

78. Which one of the following ions has the highest value of ionic radius?
(a) Li^+ (b) B^{3+} (c) O^{2-} (d) F^-

79. The wavelength of the radiation emitted, when in a hydrogen atom electron falls from infinity to stationary state 1, would be (Rydberg constant = 1.097×10^7 m^{-1}) :
(a) 91 nm (B) 192 nm (c) 406 nm (d) 9.1×10^{-8} nm

80. The correct order of bond angles (smallest first) in H_2S, NH_3, BF_3 and SiH_4 is:
(a) $H_2S < SiH_4 < NH_3 < BF_3$ (b) $NH_3 < H_2S < SiH_4 < BF_3$
(c) $H_2S < NH_3 < SiH_4 < BF_3$ (d) $H_2S < NH_3 < BF_3 < SiH_4$

81. Which one of the following sets of ions represents the collection of isoelectronic species?
(a) K^+, Ca^{2+}, Sc^{3+}, Cl^- (b) N^+, Ca^{2+}, Sc^{3+}, F^-

(c) K^+, Cl^-, Mg^{2+}, Sc^{3+} (d) Na^+, Mg^{2+}, Al^{3+}, Cl^-

(Atomic numbers F = 9, Cl = 17, Na = 11, Mg = 12, Al = 13, K = 19, Ca = 20, Sc = 21)

82. Among Al_2O_3, SiO_2, P_2O_3 and SO_2 the correct order of acid strength is:
(a) $SO_2 < P_2O_3 < SiO_2 < Al_2O_3$ (b) $SiO_2 < SO_2 < Al_2O_3 < P_2O_3$
(c) $Al_2O_3 < SiO_2 < SO_2 < P_2O_3$ (d) $Al_2O_3 < SiO_2 < P_2O_3 < SO_2$

83. The bond order in NO is 2.5 while that in NO^+ is 3. Which of the following statements is true for these two species?
(a) Bond length in NO^+ is greater than in NO (b) Bond length in NO is greater than in NO^+
(c) Bond length in NO^+ is equal to that in NO (d) Bond length is unpredictable

84. The formation of the oxide ion O^{2-} (g) requires first an exothermic and then an endothermic step as shown below.

$O(g) + e^- = O^-(g);\ \Delta H^0 = -142\ kJmol^{-1}$

$O(g)^- + e^- = O^{2-}(g);\ \Delta H^0 = 844\ kJmol^{-1}$

This is because:
(a) oxygen is more electronegative (b) oxygen has high electron affinity
(c) O^- ion will tend to resist the addition of another electron
(d) O^- ion has comparatively larger size than oxygen atom

85. The states of hybridisation of boron and oxygen atoms in boric acid (H_3BO_3) are respectively:
(a) sp^2 and sp^2 (b) sp^2 and sp^3 (c) sp^3 and sp^2 (d) sp^3 and sp^3

86. Which one of the following has the regular tetrahedral structure?
(a) XeF_4 (b) SF_4 (c) BF^-_4 (d) $[Ni(CN)_4]^{2-}$
(Atomic numbers B = 5, S = 16, Ni = 28, Xe = 54)

87. Of the following outer electronic configurations of atoms, the highest oxidation state is achieved by which one of them?
(a) $(n - 1)\ d^8ns^2$ (b) $(n - 1)\ d^5ns^1$ (c) $(n - 1)\ d^3ns^2$ (d) $(n - 1)\ d^5ns^2$

88. As the temperature is raised from 20^0C to 40^0C, the average kinetic energy of neon atoms changes by a factor of which of the following?
(a) 1/2 (b) $\sqrt{313/293}$ (c) 313/293 (d) 2

89. The maximum number of 90^0 angles between bond pair-bond pair of electrons is observed in:
(a) dsp^3 hybridisation (b) sp^3d hybridisation (c) dsp^2 hybridisation (d) sp^3d^2 hybridisation

90. Which one of the following aqueous solutions will exhibit highest boiling point?
(a) 0.01 M Na_2SO_4 (b) 0.01 M KNO_3 (c) 0.015 M urea (d) 0.015 M glucose

91. Which among the following factors is the most important in making fluorine the strongest oxidising agent?
(a) Electron affinity (b) Ionisation enthalpy
(c) Hydration enthalpy (d) Bond dissociation energy

92. In Van der Waals equation of state of the gas law, the constant 'b' is a measure of:
(a) intermolecular repulsions (b) intermolecular attraction
(c) volume occupied by the molecules (d) intermolecular collisions per unit volume

93. The conjugate base of $H_2PO_4^-$ is:
(a) PO^{3-}_4 (b) P_2O_5 (c) H_3PO_4 (d) HPO^{2-}_4

94. 6.02×10^{20} molecules of urea are present in 100 mL of its solution. The concentration of urea solution is:
(a) 0.001 M (b) 0.01 M (c) 0.02 M (d) 0.1 M

(Avogadro constant, $N_A = 6.02\times10^{23}\ mol^{-1}$)

95. To neutralise completely 20 mL of 0.1 M aqueous solution of phosphorus acid (H_3PO_3), the volume of 0.1 M aqueous KOH solution required is:

(a) 10 mL (b) 20 mL (c) 40 mL (d) 60 mL

96. For which of the following parameters the structural isomers C_2H_5OH and CH_3OCH_3 would be expected to have the same values?
(a) Heat of vaporisation (b) Vapour pressure at the same temperature
(c) Boiling points (d) Gaseous densities at the same temperature and pressure

97. Which of the following liquid pairs shows a positive deviation from Raoult's law?
(a) Water - hydrochloric acid (b) Benzene - methanol
(c) Water - nitric acid (d) Acetone - chloroform

98. Which one of the following statements is false?
(a) Raoult's law states that the vapour pressure of a component over a solution is proportional to its mole fraction
(b) The osmotic pressure (π) of a solution is given by the equation π = MRT, where M is the molarity of the solution
(c) The correct order of osmotic pressure for 0.01 M aqueous solution of each compound is $BaCl_2$ > KCl > CH_3COOH > sucrose
(d) Two sucrose solutions of same molality prepared in different solvents will have the same freezing point depression

99. What type of crystal defect is indicated in the diagram below?
Na^+, Cl^-, Na^+, Cl^-, Na^+, Cl^-
Cl^- • Cl^- Na^+ • Na^+
Na^+ Cl^-• Cl^-, Na^+ Cl^-
Cl^- Na^+ Cl^- Na^+ • Na^+
(a) Frenkel defect (b) Schottky defect (c) Interstitial defect (d) Frenkel and Schottky defects

100. An ideal gas expands in volume from $1\times10^{-3}m^3$ to $1\times10^{-2}m^3$ at 300K against a constant pressure of 1×10^5 Nm^{-2}. The work done is:
(a) -900 J (b) -900 kJ (c) 270 kJ (d) 900 kJ

101. In a hydrogen-oxygen fuel cell, combustion of hydrogen occurs to:
(a) generate heat (b) create potential difference between the two electrodes
(c) produce high purity water (d) remove absorbed oxygen from electrode surfaces

102. In a first order reaction, the concentration of the reactant, decreases from 0.8 M to 0.4 M in 15 minutes. The time taken for the concentration to change from 0.1 M to 0.025 M is:
(a) 30 min (b) 15 min (c) 7.5 min (d) 60 min

103. What is the equilibrium expression for the reaction

$$P_4(s) + 5O_2(g) \rightleftharpoons P_4O_{10}(s)?$$

(a) $K_c = \frac{[P_4O_{10}]}{[P_4][O_2]^5}$ (b) $K_c = \frac{[P_4O_{10}]}{5[P_4][O_2]}$ (c) $K_c = [O_2]^5$ (d) $K_c = \frac{1}{[O_2]^5}$

104. For the reaction,
$CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$, the K_p/K_c is equal to:
(a) 1/RT (b) RT (c) $\sqrt{RT}$ (d) 1.0

105. The equilibrium constant for the reaction

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

at temperature T is 4×10^{-4}. The value of K_c for the reaction:

$$NO(g) \rightleftharpoons \frac{1}{2}N_2(g)+\frac{1}{2}O_2(g) \text{ at the same temperature is :}$$

(a) 2.5×10^2 (b) 50 (c) 4×10^{-4} (d) 0.02

106. The rate equation for the reaction $2A + B \longrightarrow C$ is found to be : rate = k = [A][B].
(a) unit of k must be s^{-1} (b) $t_{1/2}$ is a constant
(c) rate of formation of C is twice the rate of disappearance of A
(d) value of k is independent of the initial concentrations of A and B

107. Consider the following E^0 values:
$E^0_{Fe3+/Fe2+}$ = +0.77 V
$E^0_{Sn^{2+}/Sn} = -0.14\,V$
Under standard conditions the potential for the reaction
$Sn(s) + 2Fe^{3+}(aq) \rightarrow 2Fe^{2+}(aq) + Sn^{2+}(aq)$ is:
(a) 1.68 V (b) 1.40 V (c) 0.91 V (d) 0.63 V

108. The molar solubility (in mol L^{-1}) of a sparingly soluble salt MX_4 is 's'. The corresponding solubility product is K_{sp}. s is given in terms of K_{sp} by the relation:
(a) $s = (K_{sp}/128)^{1/4}$ (b) $s = (128\ K_{sp})^{1/4}$ (c) $s = (256\ K_{sp})^{1/5}$ (d) $s = (K_{sp}/256)^{1/5}$

109. The standard e.m.f of a cell, involving one electron change is found to be 0.591 V at 25^0C. The equilibrium constant of the reaction is (F = 96,500 C mol^{-1}, R = 8.314 $JK^{-1}\ mol^{-1}$):
(a) 1.0×10^1 (b) 1.0×10^5 (c) 1.0×10^{10} (d) 1.0×10^{30}

110. The enthalpies of combustion of carbon and carbon monoxide are -393.5 and -283 kJ mol^{-1} respectively. The enthalpy of formation of carbon monoxide per mole is:
(a) 110.5 kJ (b) 676.5 kJ (c) -676.5 kJ (d) -110.5 kJ

111. The limiting molar conductivities $\wedge^0$ for NaCl, KBr and KCl are 126, 152 and 150 S $cm^2\ mol^{-1}$ respectively. The $\wedge^0$ for NaBr is:
(a) 128 S $cm^2\ mol^{-1}$ (b) 176 S $cm^2\ mol^{-1}$ (c) 278 S $cm^2\ mol^{-1}$ (d) 302 S $cm^2\ mol^{-1}$

112. In a cell that utilizes the reaction
$Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$ addition of H_2SO_4 to cathode compartment, will:
(a) lower the E and shift equilibrium to the left (b) lower the E and shift the equilibrium to the right
(c) increase the E and shift the equilibrium to the right
(d) increase the E and shift the equilibrium to the left

113. Which one of the following statements regarding helium is incorrect?
(a) It is used to fill gas balloons instead of hydrogen because it is lighter and non-inflammable
(b) It is used as a cryogenic agent for carrying out experiments at low temperatures
(c) It is used to produce and sustain powerful superconducting magnets
(d) It is used in gas-cooled nuclear reactors

114. Identify the correct statement regarding enzymes:
(a) Enzymes are specific biological catalysts that can normally function at very high temperatures (T - 1000K).
(b) Enzymes are normally heterogeneous catalysts that are very specific in their action
(c) Enzymes are specific biological catalysts that cannot be poisoned
(d) Enzymes are specific biological catalysts that possess well defined active sites.

115. One mole of magnesium nitride on the reaction with an excess of water gives:
(a) one mole of ammonia (b) one mole of nitric acid
(c) two moles of ammonia (d) two moles of nitric acid

116. Which one of the following ores is best concentrated by froth-floatation method?
(a) Magnetite (b) Cassiterite (c) Galena (d) Malachite

117. Beryllium and aluminium exhibit many properties which are similar. But, the two elements differ in:
(a) exhibiting maximum covalency in compounds (b) forming polymeric hydrides
(c) forming covalent halides (d) exhibiting amphoteric nature in their oxides

118. Aluminium chloride exists as dimer, Al_2Cl_6 in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives:

(a) $Al^{3+} + 3Cl^-$ (b) $[Al(H_2O)_6]^{3+} + 3Cl^-$ (c) $[Al(OH)_6]^{3-} + 3HCl$ (d) $Al_2O_3 + 6HCl$

119. The soldiers of Napoleon army while at Alps during freezing winter suffered a serious problem as regards to the tin buttons of their uniforms. White metallic tin buttons got converted to grey powder. This transformation is related to:
(a) a change in the crystalline structure of tin
(b) an interaction with nitrogen of the air at very low temperatures
(c) a change in the partial pressure of oxygen in the air
(d) an interaction with water vapour contained in the humid air

120. The $E^0_{M^{3+}/M^{2+}}$ values of Cr, Mn, Fe and Co are -0.41, + 1.57, +0.77 and +1.97 V respectively. For which one of these metals the change in oxidation state from +2 to +3 is easiest?
(a) Cr (b) Mn (c) Fe (d) Co

121. Excess of KI reacts with $CuSO_4$ solution and then $Na_2S_2O_3$ solution is added to it. Which of the statements is incorrect for this reaction?
(a) Cu_2I_2 is formed (b) CuI_2 is formed (c) $Na_2S_2O_3$ is oxidised (d) Evolved I_2 is reduced

122. Among the properties (A) reducing (B) oxidising (C) complexing, the set of properties shown by CN^- ion towards metal species is:
(a) A, B (b) B, C (c) C, A (d) A, B, C

123. The co-ordination number of a central metal atom in a complex is determined by:
(a) the number of ligands around a metal ion bonded by sigma bonds
(b) the number of ligands around a metal ion bonded by pi-bonds
(c) the number of ligands around a metal ion bonded by sigma and pi-bonds both
(d) the number of only anionic ligands bonded to the metal ion

124. Which one of the following complexes is an outer orbital complex?
(a) $[Fe(CN)_6]^{4-}$ (b) $[Mn(CN)_6]^{4-}$ (c) $[Co(NH_3)_6]^{3+}$ (d) $[Ni(NH_3)_6]^{2+}$

125. Co-ordination compounds have great importance in biological systems. In this context which of the following statements is incorrect?
(a) Chlorophylls are green pigments in plants and contain calcium
(b) Haemoglobin is the red pigments of blood and contains iron
(c) Cyanocobalamin is vitamin B_{12} and contains cobalt
(d) Carboxypeptidase-A is an enzyme and contains zinc

126. Cerium (Z = 58) is an important member of the lanthanides. Which of the following statements about cerium is incorrect?
(a) The common oxidation states of cerium are +3 and +4
(b) The +3 oxidation state of cerium is more stable than the +4 oxidation state
(c) The +4 oxidation state of cerium is not known in solutions
(d) Cerium (IV) acts as an oxidising agent

127. Which one of the following has largest number of isomers?
(a) $[Ru(NH_3)_4 Cl_2]^+$ (b) $[Co(NH_3)_5 Cl]^{2+}$ (c) $[Ir(PR_3)_2 H (CO)]^{2+}$ (d) $[Co(en)_2 Cl_2]^+$
(R = alkyl group, en = ethylenediamine)

128. The correct order of magnetic moments (spin only values in (B.M.) among the following is:
(a) $[MnCl_4]^{2-} > [CoCl_4]^{2-} > Fe(CN)_6]^{4-}$ (b) $[MnCl_4]^{2-} > [Fe(CN)_6]^{4-} > [CoCl_4]^{2-}$
(c) $[Fe(CN)_6]^{4-} > [MnCl_4]^{2-} > [CoCl_4]^{2-}$ (d) $[Fe(CN)_6]^{4-} > [CoCl_4]^{2-} > [MnCl_4]^{2-}$
(Atomic numbers Mn = 25, Fe = 26, Co = 27)

129. Consider the following nuclear reactions:

$$^{238}_{92}M \rightarrow ^{x}_{y}N + 2\ ^{4}_{2}He\ ;\ ^{x}_{y}N \rightarrow ^{A}_{B}L + 2\beta^+$$

The number of neutrons in the element L is:
(a) 142 (b) 144 (c) 140 (d) 146

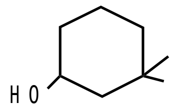
130. The half-life of a radioisotope is four hours. If the initial mass of the isotope was 200 g, the mass remaining after 24 hours undecayed is:
(a) 1.042 g (b) 2.084 g (c) 3.125 g (d) 4.167 g

131. The compound formed in the positive test for nitrogen with the Lassaigne solution of an organic compound is;
(a) $Fe_4[Fe(CN)_6]_3$ (b) $Na_3[Fe(CN)_6]$ (c) $Fe(CN)_3$ (d) $Na_4[Fe(CN)_5NOS]$

132. The ammonia evolved from the treatment of 0.30 g of an organic compound for the estimation of nitrogen was passed in 100 mL of 0.1 M sulphuric acid. The excess of acid required 20 mL of 0.5 M sodium hydroxide solution for complete neutralisation. The organic compound is:
(a) acetamide (b) benzamide (c) urea (d) thiourea

133. Which one of the following has the minimum boiling point?
(a) n-butane (b) 1-butyne (c) 1-butene (D) Isobutene

134. The IUPAC name of the compound is

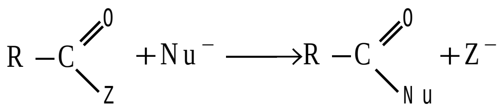


(a) 3, 3 - dimethyl - 1- hydroxy cyclohexane (b) 1, 1- dimethyl -3 - hydroxy cyclohexane
(c) 3, 3 - dimethyl -1- cyclohexanol (d) 1,1- dimethyl -3 - cyclohexanol

135. Which one of the following does not have sp^2 hybridised carbon?
(a) Acetone (b) Acetic acid (c) Acetonitrile (d) Acetamide

136. Which of the following will have a meso-isomer also?
(a) 2- chlorobutane (b) 2,3 - dichlorobutane
(c) 2,3 - dichloropentane (d) 2 - hydroxypropanoic acid

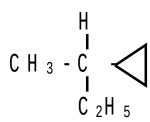
137. Rate of the reaction



is fastest when Z is:

(a) Cl (b) NH_2 (c) OC_2H_5 (d) $OCOCH_3$

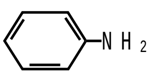
138. Amongst the following compounds, the optically active alkane having lowest molecular mass is:

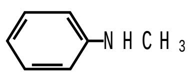
(a) $CH_3 - CH_2 - CH_2 - CH_3$ (b) $CH_3-CH_2-CH(CH_3)-CH_3$ (c) 

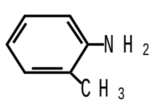
(d) $CH_3 - CH_2 - C\equiv CH$

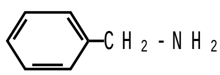
139. Consider the acidity of the carboxylic acids:
(i) PhCOOH (ii) o-$NO_2C_6H_4COOH$ (iii) p-$NO_2C_6H_4COOH$ (iv) m-$NO_2C_6H_4COOH$
Which of the following order is correct?
(a) i > ii > iii > iv (b) ii > iv > iii > i (c) ii > iv > i > iii (d) ii > iii > iv > i

140. Which of the following is the strongest base?

(a) 

(b) 

(c) 

(d) 

141. Which base is present in RNA but not in DNA?
(a) Uracil (b) Cytosine (c) Guanine (d) Thymine

142. The compound formed on heating chlorobenzene with chloral in the presence of concentrated sulphuric acid is:
(a) gammexene (b) DDT (c) freon (d) hexachloroethane

143. On mixing ethyl acetate with aqueous sodium chloride, the composition of the resultant solution is:
(a) $CH_3COOC_2H_5$ + NaCl (b) CH_3COONa + C_2H_5OH
(c) CH_3COCl + C_2H_5OH + NaOH (d) CH_3Cl + C_2H_5COONa

144. Acetyl bromide reacts with excess of CH_3MgI followed by treatment with a saturated solution of NH_4Cl gives:
(a) acetone (b) acetamide (c) 2-methyl-2-propanol (d) acetyl iodide

145. Which one of the following is reduced with zinc and hydrochloric acid to give the corresponding hydrocarbon?
(a) Ethyl acetate (b) Acetic acid (c) Acetamide (d) Butan-2-one

146. Which one of the following undergoes reaction with 50% sodium hydroxide solution to give the corresponding alcohol and acid?
(a) Phenol (b) Benzaldehyde (c) Butanal (d) Benzoic acid

147. Among the following compounds which can be dehydrated very easily?
(a) $CH_3CH_2CH_2CH_2CH_2OH$ (b) $CH_3CH_2CH_2CH(OH)CH_3$
(c) $CH_3CH_2C(CH_3)(OH)CH_2CH_3$ (d) $CH_3CH_2CH(CH_3)CH_2CH_2OH$

148. Which of the following compounds is not chiral?
(a) 1-chloropentane (b) 2-chloropentane
(c) 1-chloro-2-methyl pentane (d) 3-chloro-2-methyl pentane

149. Insulin production and its action in human body are responsible for the level of diabetes. This compound belongs to which of the following categories?
(a) A co-enzyme (b) A hormone (c) An enzyme (d) An antibiotic

150. The smog is essentially caused by the presence of:
(a) O_2 and O_3 (b) O_2 and N_2 (c) oxides of sulphur and nitrogen (d) O_3 and N_2

AIEEE 2004 Physics & Chemistry Answer Key

1.	c	51.	c	101.	b
2.	a	52.	d	102.	a
3.	c	53.	a	103.	d
4.	a	54.	b	104.	a
5.	c	55.	b	105.	b
6.	b	56.	a	106.	d
7.	d	57.	c	107.	c
8.	d	58.	b	108.	b
9.	a	59.	c	109.	c
10.	b	60.	d	110.	d
11.	a	61.	b	111.	a
12.	b	62.	b	112.	c
13.	b	63.	c	113.	c
14.	c	64.	b	114.	d
15.	b	65.	d	115.	c
16.	a	66.	c	116.	c
17.	c	67.	a	117.	a
18.	d	68.	d	118.	b
19.	a	69.	c	119.	a
20.	b	70.	c	120.	a
21.	a	71.	d	121.	b
22.	d	72.	d	122.	c
23	b	73.	c	123	a
24.	c	74.	b	124.	d
25.	c	75.	c	125.	a
26.	b	76.	c	126.	c
27.	c	77.	b	127.	d
28.	b	78.	c	128.	a
29.	b	79.	a	129.	b
30.	a	80.	c	130.	c
31.	a	81.	a	131.	a
32.	d	82.	d	132.	c
33.	b	83.	b	133.	d
34.	c	84.	c	134.	c
35.	b	85.	b	135.	c
36	d	86	c	136	b
37.	b	87.	d	137.	a
38.	a	88.	c	138.	c
39.	d	99.	d	139.	d
40.	b	90.	a	140.	d
41.	c	91.	c	141.	a
42.	d	92.	c	142.	b
43.	d	93.	d	143.	a
44.	b	94.	b	144.	c
45.	c	95.	c	145.	d
46.	c	96.	d	146.	b
47.	a	97.	b	147.	c
48.	b	98.	d	148.	a
49.	a	99.	b	149.	b
50.	c	100.	a	150.	c

MATHEMATICS (PART - II)

1. Let R = {(1, 3), (4, 2), (2, 4) (2, 3) (3, 1)} be a relation on the set A = {1, 2, 3, 4}. The relation R is:
(a) a function (b) transitive (c) not symmetric (d) reflexive

2. The range of the function $f(x) = {}^{7-x}P_{x-3}$ is:
(a) {1, 2, 3} (b) {1, 2, 3, 4, 5, 6} (c) {1, 2, 3, 4} (d) {1, 2, 3, 4, 5}

3. Let z, w be complex numbers such that $\bar{z} + i\bar{w} = 0$ and arg zw = π. Then arg z equals:
(a) $\pi/4$ (b) $\pi/2$ (c) $3\pi/4$ (d) $5\pi/4$

4. If z = x - iy and $z^{\frac{1}{3}} = p + iq$, then $\left(\frac{x}{p} + \frac{y}{q}\right) \Big/ (p^2 + q^2)$ is equal to:
(a) 1 (b) -1 (c) 2 (d) -2

5. If $|z^2 - 1| = |z|^2 + 1$, then z lies on:
(a) the real axis (b) the imaginary axis (c) a circle (d) an ellipse

6. Let $A = \begin{pmatrix} 0 & 0 & -1 \\ 0 & -1 & 0 \\ -1 & 0 & 0 \end{pmatrix}$. The only correct statement about the matrix A is:
(a) A is a zero matrix (b) A = (-1)I, where I is a unit matrix
(c) A^{-1} does not exist (d) $A^2 = I$

7. Let $A = \begin{pmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{pmatrix}$ and $(10)B = \begin{pmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{pmatrix}$. If B is inverse of matrix A, then α is:
(a) -2 (b) 1 (c) 2 (d) 5

8. If $a_1, a_2, a_3, ..., a_n, ...$ are in G.P., then the value of the determinant

$$\begin{vmatrix} \log a_n & \log a_{n+1} & \log a_{n+2} \\ \log a_{n+3} & \log a_{n+4} & \log a_{n+5} \\ \log a_{n+6} & \log a_{n+7} & \log a_{n+8} \end{vmatrix}, \text{ is :}$$

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

9. Let two numbers have arithmetic mean 9 and geometric mean 4. Then these numbers are the roots of the quadratic equation:
(a) $x^2 + 18x + 16 = 0$ (b) $x^2 - 18x + 16 = 0$ (c) $x^2 + 18x - 16 = 0$ (d) $x^2 - 18x - 16 = 0$

10. If (1 - p) is a root of quadratic equation $x^2 + px + (1 - p) = 0$ then its roots are:
(a) 0, 1 (b) -1, 1 (c) 0, -1 (d) -1, 2

11. Let S(K) = 1 + 3 + 5 + ... + (2K - 1) = 3 + K^2. Then which of the following is true?
(a) S(1) is correct (b) S(K) $\Rightarrow$ S(K + 1) (c) S(K) $\neq$ S(K + 1)
(d) Principle of mathematical induction can be used to prove the formula

12. How many ways are there to arrange the letters in the word GARDEN with the vowels in alphabetical order?
(a) 120 (b) 240 (c) 360 (d) 480

13. The number of ways of distributing 8 identical balls in 3 distinct boxes so that none of the boxes is empty is:
(a) 5 (b) 21 (c) 3^8 (d) ${}^8C_3$

14. If one root of the equation $x^2 + px + 12 = 0$ is 4, while the equation $x^2 + px + q = 0$ has equal roots, then the value of 'q' is:
(a) $\frac{49}{4}$ (b) 12 (c) 3 (d) 4

15. The coefficient of the middle term in the binomial expansion in powers of x of $(1+\alpha x)^4$ and of $(1-\alpha x)^6$ is the same if α equals:
(a) $-\frac{5}{3}$ (b) $\frac{10}{3}$ (c) $-\frac{3}{10}$ (d) $\frac{3}{5}$

16. The coefficient of x^n in expansion of $(1 + x)(1 - x)^n$ is:
(a) $(n - 1)$ (b) $(-1)^n(1 - n)$ (c) $(-1)^{n-1}(n - 1)^2$ (d) $(-1)^{n-1}n$

17. If $s_n = \sum_{r=0}^{n} \frac{1}{{}^nC_r}$ and $t_n = \sum_{r=0}^{n} \frac{r}{{}^nC_r}$, then $\frac{t_n}{s_n}$ is equal to:
(a) $\frac{1}{2}n$ (b) $\frac{1}{2}n-1$ (c) $n - 1$ (d) $\frac{2n-1}{2}$

18. Let T_r be the rth term of an A.P. whose first term is a and common difference is d. If for some positive integers m, n, $m \neq n$, $T_m = \frac{1}{n}$ and $T_n = \frac{1}{m}$, then a - d equals:
(a) 0 (b) 1 (c) $\frac{1}{mn}$ (d) $\frac{1}{m}+\frac{1}{n}$

19. The sum of the first n terms of the series $1^2 + 2.\ 2^2 + 3^2 + 2.\ 4^2 + 5^2 + 2.\ 6^2 + ...$ is $\frac{n(n+1)^2}{2}$ when n is even. When n is odd the sum is:
(a) $\frac{3n(n+1)}{2}$ (b) $\frac{n^2(n+1)}{2}$ (c) $\frac{n(n+1)^2}{4}$ (d) $\left[\frac{n(n+1)}{2}\right]^2$

20. The sum of series $\frac{1}{2!}+\frac{1}{4!}+\frac{1}{6!}+........$ is:
(a) $\frac{(e^2-1)}{2}$ (b) $\frac{(e-1)^2}{2e}$ (c) $\frac{(e^2-1)}{2e}$ (d) $\frac{(e^2-2)}{e}$

21. Let α, β be such that $\pi < \alpha - \beta < 3\pi$. If $\sin\alpha + \sin\beta = -\frac{21}{65}$ and $\cos\alpha + \cos\beta = -\frac{27}{65}$, then the value of $\cos\frac{\alpha-\beta}{2}$ is:
(a) $-\frac{3}{\sqrt{130}}$ (b) $\frac{3}{\sqrt{130}}$ (c) $\frac{6}{65}$ (d) $-\frac{6}{65}$

22. If $u=\sqrt{a^2\cos^2\theta+b^2\sin^2\theta}+\sqrt{a^2\sin^2\theta+b^2\cos^2\theta}$ then the difference between the maximum and minimum values of u^2 is given by:

(a) $2(a^2 + b^2)$ (b) $2\sqrt{a^2+b^2}$ (c) $(a + b)^2$ (d) $(a - b)^2$

23. The sides of a triangle are $\sin\alpha, \cos\alpha$ and $\sqrt{1+\sin\alpha\cos\alpha}$ for some $0<\alpha<\frac{\pi}{2}$. Then the greatest angle of the triangle is:

(a) 60^0 (b) 90^0 (c) 120^0 (d) 150^0

24. A person standing on the bank of a river observes that the angle of elevation of the top of a tree on the opposite bank of the river is 60^0 and when he retires 40 meters away from the tree the angle of elevation becomes 30^0. The breadth of the river is:

(a) 20 m (b) 30 m (c) 40 m (d) 60 m

25. If f : $R\rightarrow S$, defined by $f(x)=\sin x-\sqrt{3}\cos x+1$, is onto, then the interval of S is:

(a) [0, 3] (b) [-1, 1] (c) [0, 1] (d) [-1, 3]

26. The graph of the function y = f(x) is symmetrical about the line x = 2, then:

(a) f(x + 2) = f(x - 2) (b) f(2 + x) = f(2 - x) (c) f(x) = f(-x) (d) f(x) = -f(-x)

27. The domain of the function $f(x)=\frac{\sin^{-1}(x-3)}{\sqrt{9-x^2}}$ is:

(a) [2, 3] (b) [2, 3) (c) [1, 2] (d) [1, 2)

28. If $\lim_{x\to\infty}\left(1+\frac{a}{x}+\frac{b}{x^2}\right)^{2x}=e^2$, then the values of a and b, are:

(a) $a\in R, b\in R$ (b) $a = 1, b\in R$ (c) $a\in R, b = 2$ (d) a = 1, b = 2

29. Let $f(x)=\frac{1-\tan x}{4x-\pi}, x\neq\frac{\pi}{4}, x\in\left[0, \frac{\pi}{2}\right]$. If f(x) is continuous in $\left[0, \frac{\pi}{2}\right]$, then $f\left(\frac{\pi}{4}\right)$ is:

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

30. If $x=e^{y+e^{y+\ldots\text{to }\infty}}, x>0$, then $\frac{dy}{dx}$ is:

(a) $\frac{x}{1+x}$ (b) $\frac{1}{x}$ (c) $\frac{1-x}{x}$ (d) $\frac{1+x}{x}$

31. A point on the parabola $y^2 = 18x$ at which the ordinate increases at twice the rate of the abscissa is:

(a) (2, 4) (b) (2, -4) (c) $\left(\frac{-9}{8}, \frac{9}{2}\right)$ (d) $\left(\frac{9}{8}, \frac{9}{2}\right)$

32. A function y = f(x) has a second order derivative f" = 6(x - 1). If its graph passes through the point (2, 1) and at that point the tangent to the graph is y = 3x - 5, then the function is:

(a) $(x - 1)^2$ (b) $(x - 1)^3$ (c) $(x + 1)^3$ (d) $(x + 1)^2$

33. The normal to the curve $x = a(1 + \cos\theta)$, $y = a\sin\theta$ at 'θ' always passes through the fixed point:

(a) (a, 0) (b) (0, a) (c) (0, 0) (d) (a, a)

34. If 2a + 3b + 6c = 0, then at least one root of the equation $ax^2 + bx + c = 0$ lies in the interval:
(a) (0, 1) (b) (1, 2) (c) (2, 3) (d) (1, 3)

35. $\lim_{n\to\infty} \sum_{r=1}^{n} \frac{1}{n} e^{r/n}$ is:
(a) e (b) e - 1 (c) 1 - e (d) e + 1

36. If $\int \frac{\sin x}{\sin(x-\alpha)} dx = Ax + B \log\sin(x-\alpha) + C$, then value of (A, B) is:
(a) $(\sin\alpha, \cos\alpha)$ (b) $(\cos\alpha, \sin\alpha)$ (c) $(-\sin\alpha, \cos\alpha)$ (d) $(-\cos\alpha, \sin\alpha)$

37. $\int \frac{dx}{\cos x - \sin x}$ is equal to:
(a) $\frac{1}{\sqrt{2}} \log\left|\tan\left(\frac{x}{2} - \frac{\pi}{8}\right)\right| + c$ (b) $\frac{1}{\sqrt{2}} \log\left|\cot\left(\frac{x}{2}\right)\right| + c$ (c) $\frac{1}{\sqrt{2}} \log\left|\tan\left(\frac{x}{2} - \frac{3\pi}{8}\right)\right| + c$ (d) $\frac{1}{\sqrt{2}} \log\left|\tan\left(\frac{x}{2} + \frac{3\pi}{8}\right)\right| + c$

38. The value of $\int_{-2}^{3} |1-x^2|\, dx$ is:
(a) $\frac{28}{3}$ (b) $\frac{14}{3}$ (c) $\frac{7}{3}$ (d) $\frac{1}{3}$

39. The value of $I = \int_0^{\pi/2} \frac{(\sin x + \cos x)^2}{\sqrt{1+\sin 2x}} dx$ is:
(a) 0 (b) 1 (c) 2 (d) 3

40. If $\int_0^{\pi} x f(\sin x)\, dx = A \int_0^{\pi/2} f(\sin x) dx$, then A is equal to:
(a) 0 (b) π (c) $\frac{\pi}{4}$ (d) 2π

41. If $f(x) = \frac{e^x}{1+e^x}$, $I_1 = \int_{f(-a)}^{f(a)} xg\{x(1-x)\}\, dx$ and $I_2 = \int_{f(-a)}^{f(a)} g\{x(1-x)\}dx$, then the value of $\frac{I_2}{I_1}$ is:
(a) 2 (b) -3 (c) -1 (d) 1

42. The area of the region bounded by the curves y = |x - 2|, x = 1, x = 3 and the x-axis is:
(a) 1 (b) 2 (c) 3 (d) 4

43. The differential equation for the family of curves $x^2 + y^2 - 2ay = 0$, where a is an arbitrary constant is:
(a) $2(x^2 - y^2)y' = xy$ (b) $2(x^2 + y^2)y' = xy$ (c) $(x^2 - y^2)y' = 2xy$ (d) $(x^2 + y^2)y' = 2xy$

44. The solution of the differential equation $ydx + (x + x^2y)\, dy = 0$ is:
(a) $-\frac{1}{xy} = c$ (b) $-\frac{1}{xy} + \log y = c$ (c) $\frac{1}{xy} + \log y = c$ (d) log y = cx

45. Let A (2, -3) and B (-2, 1) be vertices of a triangle ABC. If the centroid of this triangle moves on the line 2x + 3y = 1, then the locus of the vertex C is the line:
(a) 2x + 3y = 9 (b) 2x - 3y = 7 (c) 3x + 2y = 5 (d) 3x - 2y = 3

46. The equation of the straight line passing through the point (4, 3) and making intercepts on the co-ordinate axes whose sum is -1 is:
(a) $\frac{x}{2} + \frac{y}{3} = -1$ and $\frac{x}{-2} + \frac{y}{1} = -1$ (b) $\frac{x}{2} - \frac{y}{3} = -1$ and $\frac{x}{-2} + \frac{y}{1} = -1$

(c) $\frac{x}{2}+\frac{y}{3}=1$ and $\frac{x}{-2}+\frac{y}{1}=1$ (d) $\frac{x}{2}-\frac{y}{3}=1$ and $\frac{x}{-2}+\frac{y}{1}=1$

47. If the sum of the slopes of the lines given by $x^2 - 2cxy - 7y^2 = 0$ is four times their product, then c has the value:
(a) 1 (b) -1 (c) 2 (d) -2

48. If one of the lines given by $6x^2 - xy + 4cy^2 = 0$ is $3x + 4y = 0$, then c equals:
(a) 1 (b) -1 (d) 3 (d) -3

49. If a circle passes through the point (a, b) and cuts the circle $x^2 + y^2 = 4$ orthogonally, then the locus of its centre is:
(a) $2ax + 2by + (a^2 + b^2 + 4) = 0$ (b) $2ax + 2by - (a^2 + b^2 + 4) = 0$
(c) $2ax - 2by + (a^2 + b^2 + 4) = 0$ (d) $2ax - 2by - (a^2 + b^2 + 4) = 0$

50. A variable circle passes through the fixed point A(p, q) and touches x-axis. The locus of the other end of the diameter through A is:
(a) $(x - p)^2 = 4qy$ (b) $(x - q)^2 = 4py$ (c) $(y - p)^2 = 4qx$ (d) $(y - q)^2 = 4px$

51. If the lines $2x + 3y + 1 = 0$ and $3x - y - 4 = 0$ lie along diameters of a circle of circumference 10π, then the equation of the circle is:
(a) $x^2 + y^2 - 2x + 2y - 23 = 0$ (b) $x^2 + y^2 - 2x - 2y - 23 = 0$
(c) $x^2 + y^2 + 2x + 2y - 23 = 0$ (d) $x^2 + y^2 + 2x - 2y - 23 = 0$

52. The intercept on the line y = x by the circle $x^2 + y^2 - 2x = 0$ is AB. Equation of the circle on AB as a diameter is:
(a) $x^2 + y^2 - x - y = 0$ (b) $x^2 + y^2 - x + y = 0$ (c) $x^2 + y^2 + x + y = 0$ (d) $x^2 + y^2 + x - y = 0$

53. If $a \neq 0$ and the line $2bx + 3cy + 4d = 0$ passes through the points of intersection of the parabolas $y^2 = 4ax$ and $x^2 = 4ay$, then:
(a) $d^2 + (2b + 3c)^2 = 0$ (b) $d^2 + (3b + 2c)^2 = 0$ (c) $d^2 + (2b - 3c)^2 = 0$ (d) $d^2 + (3b - 2c)^2 = 0$

54. The eccentricity of an ellipse, with its centre at the origin, is $\frac{1}{2}$. If one of the directrices is x = 4, then the equation of the ellipse is:
(a) $3x^2 + 4y^2 = 1$ (b) $3x^2 + 4y^2 = 12$ (c) $4x^2 + 3y^2 = 12$ (d) $4x^2 + 3y^2 = 1$

55. A line makes the same angle θ, with each of the x and z axis. If the angle β, which it makes with y-axis, is such that $\sin^2\beta = 3\sin^2\theta$, then $\cos^2\theta$ equals:
(a) $\frac{2}{3}$ (b) $\frac{1}{5}$ (c) $\frac{3}{5}$ (d) $\frac{2}{5}$

56. Distance between two parallel planes $2x + y + 2z = 8$ and $4x + 2y + 4z + 5 = 0$ is:
(a) $\frac{3}{2}$ (b) $\frac{5}{2}$ (c) $\frac{7}{2}$ (d) $\frac{9}{2}$

57. A line with direction cosines proportional to 2, 1, 2 meets each of the line x = y + a = z and x + a = 2y = 2z. The co-ordinates of each of the points of intersection are given by:
(a) (3a, 3a, 3a,), (a, a, a) (b) (3a, 2a, 3a), (a, a, a)
(c) (3a, 2a, 3a,), (a, a, 2a) (d) (2a, 3a, 3a), (2a, a, a)

58. If the straight lines $x = 1 + s$, $y = -3 - \lambda s$, $z = 1 + \lambda s$ and $x = \frac{t}{2}$, $y = 1 + t$, $z = 2 - t$, with parameter s and t respectively, are co-planar, then λ equals:
(a) -2 (b) -1 (c) $-\frac{1}{2}$ (d) 0

59. The intersection of the spheres $x^2 + y^2 + z^2 + 7x - 2y - z = 13$ and $x^2 + y^2 + z^2 - 3x + 3y + 4z = 8$ is the same as the intersection of one of the sphere and the plane:
(a) $x - y - z = 1$ (b) $x - 2y - z = 1$ (c) $x - y - 2z = 1$ (d) $2x - y - z = 1$

60. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-zero vectors such that no two of these are collinear. If the vector $\vec{a}+2\vec{b}$ is collinear with $\vec{c}$ and $\vec{b}+3\vec{c}$ is collinear with $\vec{a}$ (λ being some non-zero scalar) then $\vec{a}+2\vec{b}+6\vec{c}$ equals:

(a) $\lambda\vec{a}$ (b) $\lambda\vec{b}$ (c) $\lambda\vec{c}$ (d) 0

61. A particle is acted upon by constant forces $4\hat{i}+\hat{j}-3\hat{k}$ and $3\hat{i}+\hat{j}-\hat{k}$ which displace it from a point $\hat{i}+2\hat{j}+3\hat{k}$ to the point $5\hat{i}+4\hat{j}+\hat{k}$. The work done is standard units by the forces is given by:

(a) 40 (b) 30 (c) 25 (d) 15

62. If $\bar{a}, \bar{b}, \bar{c}$ are non-coplanar vectors and λ is a real number, then the vectors $\bar{a}+2\bar{b}+3\bar{c}$, $\lambda\bar{b}+4\bar{c}$ and $(2\lambda-1)\bar{c}$ are non-coplanar for:

(a) all values of λ (b) all except one value of λ

(c) all except two values of λ (d) no value of λ

63. Let $\bar{u}, \bar{v}, \bar{w}$ be such that $|\bar{u}|=1, |\bar{v}|=2, |\bar{w}|=3$. If the projection $\bar{v}$ along $\bar{u}$ is equal to that of $\bar{w}$ along $\bar{u}$ and $\bar{v}, \bar{w}$ are perpendicular to each other then $|\bar{u}-\bar{v}+\bar{w}|$ equals:

(a) 2 (b) $\sqrt{7}$ (c) $\sqrt{14}$ (d) 14

64. Let $\bar{a}$, $\bar{b}$ and $\bar{c}$ be non-zero vectors such that $(\bar{a}\times\bar{b})\times\bar{c}=\frac{1}{3}|\bar{b}||\bar{c}|\bar{a}$. If θ is the acute angle between the vectors $\bar{b}$ and $\bar{c}$, then sin θ equals:

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

65. Consider the following statements:

(i) Mode can be computed from histogram (ii) Median is not independent of change of scale

(iii) Variance is independent of change of origin and scale

Which of these is/are correct?

(a) only (i) (b) only (ii) (c) only (i) and (ii) (d) (i), (ii) and (iii)

66. In a series of 2n observations, half of them equal a and remaining half equal -a. If the standard deviation of the observations is 2, then |a| equals:

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

67. The probability that A speaks truth is $\frac{4}{5}$ while this probability for B is $\frac{3}{4}$. The probability that they contradict each other when asked to speak on a fact is:

(a) $\frac{3}{20}$ (b) $\frac{1}{5}$ (c) $\frac{7}{20}$ (d) $\frac{4}{5}$

68. A random variable X has the probability distribution:

X:	1	2	3	4	5	6	7	8
P(X):	0.15	0.23	0.12	0.10	0.20	0.08	0.07	0.05

For the events E = {X is a prime number} and F = {X < 4}, the probability P(E $\cup$ F) is:

(a) 0.87 (b) 0.77 (c) 0.35 (d) 0.50

69. The mean and the variance of a binomial distribution are 4 and 2 respectively. Then the probability of 2 successes is:

(a) $\frac{37}{256}$ (b) $\frac{219}{256}$ (c) $\frac{128}{256}$ (d) $\frac{28}{256}$

70. With two forces acting at a point, the maximum effect is obtained when their resultant is 4N. If they act at right angles, then their resultant is 3N. Then the forces are

(a) $(2+\sqrt{2})\,\text{N}$ and $(2-\sqrt{2})\,\text{N}$ (b) $(2+\sqrt{3})\,\text{N}$ and $(2-\sqrt{3})\,\text{N}$

(c) $\left(2+\frac{1}{2}\sqrt{2}\right)\text{N}$ and $\left(2-\frac{1}{2}\sqrt{2}\right)\text{N}$ (d) $\left(2+\frac{1}{2}\sqrt{3}\right)\text{N}$ and $\left(2-\frac{1}{2}\sqrt{3}\right)\text{N}$

71. In a right angle ΔABC, $\angle A = 90^0$ and sides a, b, c are respectively, 5cm, 4 cm and 3 cm. If a force $\vec{F}$ has moments 0, 9 and 16 in N cm unit respectively about vertices A, B and C, the magnitude of $\vec{F}$ is:

(a) 3 (b) 4 (c) 5 (d) 9

72. Three forces $\vec{P}, \vec{Q}$ and $\vec{R}$ acting along IA, IB and IC, where I is the incentre of a ΔABC, are in equilibrium. Then $\vec{P}:\vec{Q}:\vec{R}$ is:

(a) $\cos\frac{A}{2}:\cos\frac{B}{2}:\cos\frac{C}{2}$ (b) $\sin\frac{A}{2}:\sin\frac{B}{2}:\sin\frac{C}{2}$ (c) $\sec\frac{A}{2}:\sec\frac{B}{2}:\sec\frac{C}{2}$ (d) $\operatorname{cosec}\frac{A}{2}:\operatorname{cosec}\frac{B}{2}:\operatorname{cosec}\frac{C}{2}$

73. A particle moves towards east from a point A to a point B at the rate of 4 km/h and then towards north from B to C at rate of 5 km/h. If AB = 12 km and BC = 5 km, then its average speed for its journey from A to C and resultant average velocity direct from A to C are respectively:

(a) $\frac{17}{4}\,\text{km/h}$ and $\frac{13}{4}\,\text{km/h}$ (b) $\frac{13}{4}\,\text{km/h}$ and $\frac{17}{4}\,\text{km/h}$

(c) $\frac{17}{9}\,\text{km/h}$ and $\frac{13}{9}\,\text{km/h}$ (d) $\frac{13}{9}\,\text{km/h}$ and $\frac{17}{9}\,\text{km/h}$

74. A velocity $\frac{1}{4}$ m/s is resolved into two components along OA and OB making angles 30^0 and 45^0 respectively with the given velocity. Then the component along OB is:

(a) $\frac{1}{8}\,\text{m/s}$ (b) $\frac{1}{4}(\sqrt{3}-1)\,\text{m/s}$ (c) $\frac{1}{4}\,\text{m/s}$ (d) $\frac{1}{8}(\sqrt{6}-\sqrt{2})\,\text{m/s}$

75. If t_1 and t_2 are the times of flight of two particles having the same initial velocity u and range R on the horizontal, then $t_1^2 + r_2^2$ is equal to:

(a) $\frac{u^2}{g}$ (b) $\frac{4u^2}{g^2}$ (c) $\frac{u^2}{2g}$ (d) 1

AIEEE 2004 Mathematics Answer Key

1.	c	26.	b	51.	a
2.	a	27.	b	52.	a
3.	c	28.	b	53.	a
4.	d	29.	c	54.	b
5.	b	30.	c	55.	c
6.	d	31.	d	56.	c
7.	d	32.	b	57.	b
8.	a	33.	a	58.	a
9.	b	34.	a	59.	d
10.	c	35.	b	60.	d
11.	b	36	b	61.	a
12.	c	37.	d	62.	c
13.	b	38.	a	63.	c
14.	a	39.	c	64.	d
15.	c	40.	b	65.	c
16.	b	41.	a	66.	c
17.	a	42.	a	67.	c
18.	a	43.	c	68.	b
19.	b	44.	b	69.	d
20.	b	45.	a	70.	c
21.	a	46.	d	71.	c
22.	d	47.	c	72.	a
23	c	48.	d	73.	a
24.	a	49.	b	74.	d
25.	d	50.	a	75.	b