UPSEE - 2007

Physics

1. 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) $\log_e x$

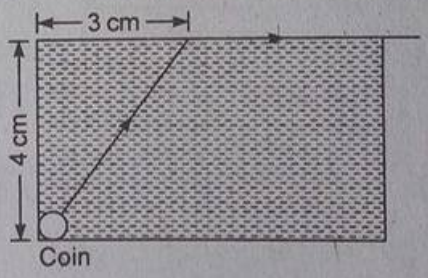
2. A ball is thrown from a point with a speed v_0 at an angle of projection θ. From the same point and at the same instant, a person starts running with a constant speed $\frac{v_0}{2}$ to catch the ball. Will the person be able to catch the ball ? If yes, what should be the angle of projection ?
   (a) Yes, 60° (b) Yes, 30°
   (c) No (d) Yes, 45°

3. 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

4. Nickel shows ferromagnetic property at room temperature. If the temperature is increased beyond Curie temperature, then it will show
   (a) paramagnetism
   (b) anti-ferromagnetism
   (c) no magnetic property
   (d) diamagnetism

5. In radioactive decay process, the negatively charged emitted β-particles are
   (a) the electrons present inside the nucleus
   (b) the electrons produced as a result of the decay of neutrons inside the nucleus
   (c) the electrons produced as a result of collisions between atoms
   (d) the electrons orbiting around the nucleus

6. A small coin is resting on the bottom of a beaker filled with a liquid. A ray of light from the coin travels upto the surface of the liquid and moves along its surface (see figure).



   How fast is the light travelling in the liquid ?
   (a) 1.8×10^8 m/s (b) 2.4×10^8 m/s
   (c) 3.0×10^8 m/s (d) 1.2×10^8 m/s

7. What is the value of inductance L for which the current is a maximum in a series LCR circuit with $C = 10\ \mu F$ and $\omega = 1000\ s^{-1}$?
   (a) 100 mH
   (b) 1 mH
   (c) Cannot be calculated unless R is known
   (d) 10 mH

8. Three point charges $+q$, $-2q$ and $+q$ are placed at points $(x = 0,\ y = a,\ z = 0)$, $(x = 0,\ y = 0,$

$(x = a, y = 0, z = 0)$, respectively. itude and direction of the electric nent vector of this charge assembly are

(a) $\sqrt{2}\,qa$ along $+y$ direction

(b) $\sqrt{2}\,qa$ along the line joining points $(x = 0, y = 0, z = 0)$ and $(x = a, y = a, z = 0)$

(c) qa along the line joining points $(x = 0, y = 0, z = 0)$ and $(x = a, y = a, z = 0)$

(d) $\sqrt{2}qa$ along $+x$ direction

9. A nucleus ${}^{A}_{Z}X$ has mass represented by $M(A, Z)$. If M_p and M_n denote the mass of proton and neutron respectively and BE the binding energy (in MeV), then

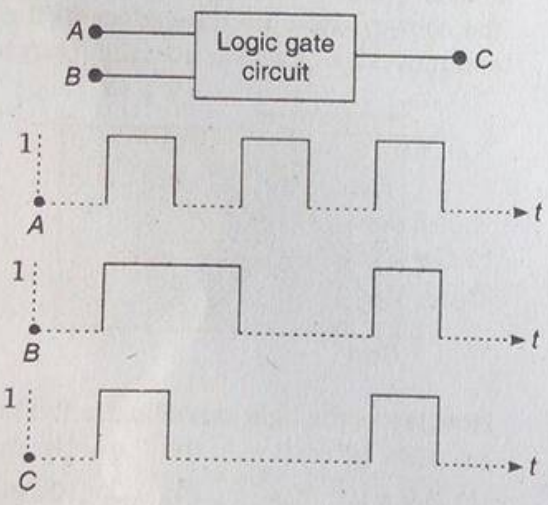
(a) $BE = [M(A, Z) - ZM_p - (A - Z)M_n]c^2$

(b) $BE = [ZM_p + (A - Z)M_n - M(A, Z)]c^2$

(c) $BE = [ZM_p + AM_n - M(A, Z)]c^2$

(d) $BE = M(A, Z) - ZM_p - (A - Z)M_n$

10. The following figure shows a logic gate circuit with two inputs A and B and the output C. The voltage waveforms of A, B and C are as shown below



The logic circuit gate is

(a) AND gate (b) NAND gate

(c) NOR gate (d) OR gate

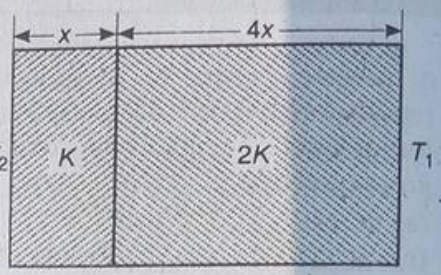
11. Assuming the sun to have a spherical outer surface of radius r, radiating like a black body at temperature $t°C$, the power received by a unit surface, (normal to the incident rays) at a distance R from the centre of the sun is

(a) $\dfrac{4\pi r^2\sigma t^4}{R^2}$ (b) $\dfrac{r^2\sigma(t + 273)^4}{4\pi R^2}$

(c) $\dfrac{16\pi^2 r^2\sigma t^4}{R^2}$ (d) $\dfrac{r^2\sigma(t + 273)^4}{R^2}$

where σ is the Stefan's constant.

12. 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

13. 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

14. 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) $\dfrac{3F}{8}$

15. In gamma ray emission from a nucleus

(a) both the neutron number and the proton number change

(b) there is no change in the proton number and the neutron number

(c) only the neutron number changes

(d) only the proton number changes

ting from the origin (0, 0) moves line in the (x, y) plane. Its coordinates at a later time are $(\sqrt{3}, 3)$. The path of the particle makes with the x-axis an angle of

(a) 30° (b) 45°
(c) 60° (d) 0°

17. A wheel has angular acceleration of 3.0 rad/s^2 and an initial angular speed of 2.00 rad/s. In a time of 2 s it has rotated through an angle (in radian) of

(a) 6 (b) 10
(c) 12 (d) 4

18. The resistance of an ammeter is 13Ω and its scale is graduated for a current upto 100 A. After an additional shunt has been connected to this ammeter it becomes possible to measure currents upto 750 A by this meter. The value of shunt resistance is

(a) 20Ω (b) 2Ω
(c) 0.2Ω (d) 2 kΩ

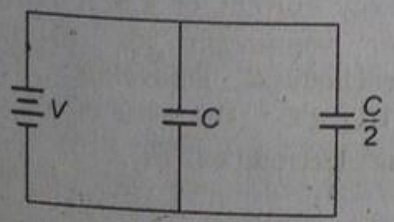
19. Under the influence of a uniform magnetic field a charged particle is moving in a circle of radius R with constant speed v. The time period of the motion

(a) depends on v and not on R
(b) depends on both R and v
(c) is independent of both R and v
(d) depends on R and not on v

20. The primary and secondary coils of a transformer have 50 and 1500 turns respectively. If the magnetic flux ϕ linked with the primary coil is given by $\phi = \phi_0 + 4t$, where ϕ is in weber, t is time in second and ϕ_0 is a constant, the output voltage across the secondary coil is

(a) 90 V (b) 120 V
(c) 220 V (d) 30 V

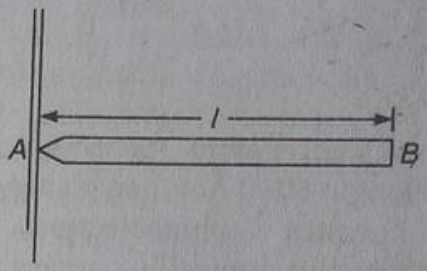
21. Two condensers, one of capacity C and the other of capacity $\frac{C}{2}$, are connected to a V volt battery, as shown.



The work done in charging fully both the condensers is

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

22. A uniform rod AB of length l and mass m is free to rotate about point A. The rod is released from rest in the horizontal position. Given that the moment of inertia of the rod about A is $\frac{ml^2}{3}$, the initial angular acceleration of the rod will be

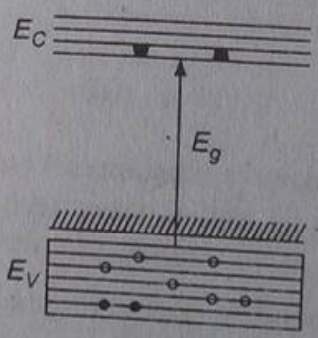


(a) $\frac{2g}{3l}$ (b) $mg\frac{l}{2}$
(c) $\frac{3}{2}gl$ (d) $\frac{3g}{2l}$

23. The frequency of a light wave in a material is 2×10^{14} Hz and wavelength is 5000 Å. The refractive index of material will be

(a) 1.40 (b) 1.50
(c) 3.00 (d) 1.33

24. In the energy band diagram of a material shown below, the open circles and filled circles denote holes and electrons respectively. The material is a/an



(a) p-type semiconductor
(b) insulator
(c) metal
(d) n-type semiconductor

from X to Y with a uniform speed ns to Y with a uniform speed v_d. speed for this round trip is

(a) $\frac{2v_dv_u}{v_d+v_u}$ (b) $\sqrt{v_uv_d}$

(c) $\frac{v_dv_u}{v_d+v_u}$ (d) $\frac{v_u+v_d}{2}$

26. A particle executes simple harmonic oscillation with an amplitude a. The period of oscillation is T. The minimum time taken by the particle to travel half of the amplitude from the equilibrium position is

(a) $\frac{T}{4}$ (b) $\frac{T}{8}$

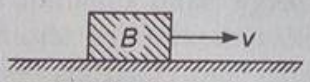
(c) $\frac{T}{12}$ (d) $\frac{T}{2}$

27. A 5 W source emits monochromatic light of wavelength 5000 Å. When placed 0.5 m away, it liberates photoelectrons from a photosensitive metallic surface. When the source is moved to a distance of 1.0 m, the number of photoelectrons liberated will be reduced by a factor of

(a) 4 (b) 8

(c) 16 (d) 2

28. A block B is pushed momentarily along a horizontal surface with an initial velocity v. If μ is the coefficient of sliding friction between B and the surface, block B will come to rest after a time



(a) $\frac{v}{g\mu}$ (b) $\frac{g\mu}{v}$

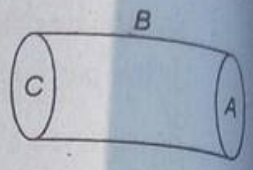
(c) $\frac{g}{v}$ (d) $\frac{v}{g}$

29. Two radioactive substances A and B have decay constants 5λ and λ respectively. At $t = 0$ they have the same number of nuclei. The ratio of number of nuclei of A to those of B will be $\left(\frac{1}{e}\right)^2$ after a time interval

(a) $\frac{1}{4\lambda}$ (b) 4λ

(c) 2λ (d) $\frac{1}{2\lambda}$

30. A hollow cylinder has a charge q coulomb within it. If ϕ is the electric flux in unit of voltmeter associated with the curved surface B, the flux linked with the plane surface A in unit of voltmeter will be



(a) $\frac{1}{2}\left(\frac{q}{\varepsilon_0}-\phi\right)$ (b) $\frac{q}{2\varepsilon_0}$

(c) $\frac{\phi}{3}$ (d) $\frac{q}{\varepsilon_0}-\phi$

31. A transformer is used to light a 100 W and 110 V lamp from a 220 V mains. If the main current is 0.5 A, the efficiency of the transformer is approximately

(a) 30% (b) 50%

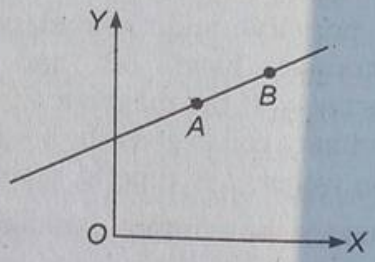
(c) 90% (d) 10%

32. A charged particle (charge q) is moving in a circle of radius R with uniform speed v. The associated magnetic moment μ is given by

(a) $\frac{qvR}{2}$ (b) qvR^2

(c) $\frac{qvR^2}{2}$ (d) qvR

33. A particle of mass m moves in the XY plane with a velocity v along the straight line AB. If the angular momentum of the particle with respect to origin O is L_A when it is at A and L_B when it is at B, then



(a) $L_A > L_B$

(b) $L_A = L_B$

(c) the relationship between L_A and L_B depends upon the slope of the line AB

(d) $L_A < L_B$

34. A steady current of 1.5 A flows through a copper voltameter for 10 min. If the electrochemical equivalent of copper is 30×10^{-5} g C^{-1}, the mass of copper deposited on the electrode will be

(b) 0.50 g
(d) 0.27 g

trometer used for measuring the masses of ions, the ions are initially accelerated by an electric potential V and then made to describe semicircular paths of radius R using a magnetic field B. If V and B are kept constant, the ratio $\left(\frac{\text{charge on the ion}}{\text{mass of the ion}}\right)$ will be proportional to

(a) $\frac{1}{R}$ (b) $\frac{1}{R^2}$

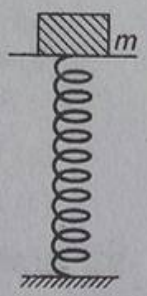
(c) R^2 (d) R

36. Three resistances P, Q, R each of 2Ω and an unknown resistance S form the four arms of a Wheatstone's bridge circuit. When a resistance of 6Ω is connected in parallel to S the bridge gets balanced. What is the value of S ?

(a) 2Ω (b) 3Ω

(c) 6Ω (d) 1Ω

37. A mass of 2.0 kg is put on a flat pan attached to a vertical spring fixed on the ground as shown in the figure. The mass of the spring and the pan is negligible. When pressed slightly and released the mass executes a simple harmonic motion. The spring constant is 200 N/m. What should be the minimum amplitude of the motion, so that the mass gets detached from the pan ? (Take $g = 10\ m/s^2$)

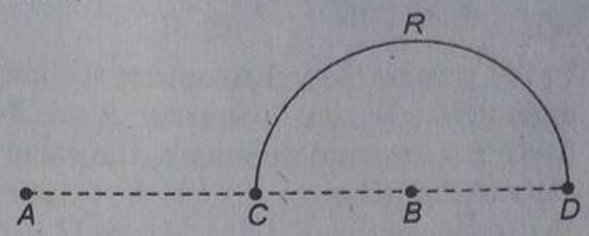


(a) 8.0 cm
(b) 10.0 cm
(c) Any value less than 12.0 cm
(d) 4.0 cm

38. Two satellites of earth, S_1 and S_2, are moving in the same orbit. The mass of S_1 is four times the mass of S_2. Which one of the following statements is true ?

(a) The time period of S_1 is four times that of S_2
(b) The potential energies of earth and satellite in the two cases are equal
(c) S_1 and S_2 are moving with the same speed
(d) The kinetic energies of the two satellites are equal

39. Charges $+q$ and $-q$ are placed at points A and B respectively which are a distance $2L$ apart, C is the midpoint between A and B. The work done in moving a charge $+Q$ along the semicircle CRD is



(a) $\frac{qQ}{4\pi\varepsilon_0 L}$ (b) $\frac{qQ}{2\pi\varepsilon_0 L}$

(c) $\frac{qQ}{6\pi\varepsilon_0 L}$ (d) $-\frac{qQ}{6\pi\varepsilon_0 L}$

40. A beam of electrons passes undeflected through mutually perpendicular electric and magnetic fields. If the electric field is switched off, and the same magnetic field is maintained, the electrons move

(a) in an elliptical orbit
(b) in a circular orbit
(c) along a parabolic path
(d) along a straight line

41. Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2×10^{-3} W. The number of photons emitted, on the average, by the source per second is

(a) 5×10^{15} (b) 5×10^{16}

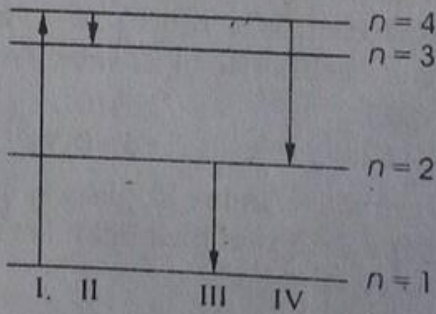
(c) 5×10^{17} (d) 5×10^{14}

42. The length of a magnet is large compared to its width and breadth. The time period of its oscillation in a vibration magnetometer is 2 s. 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

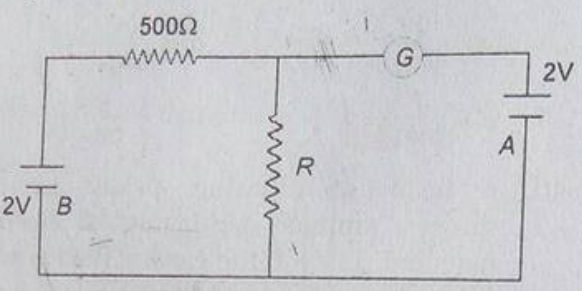
43. The diagram shows the energy levels for an electron in a certain atom. Which transition



presents the emission of a photon ost energy ?

(a) III (b) IV
(c) I (d) II

44. In the circuit, the galvanometer G shows zero deflection. If the batteries A and B have negligible internal resistance, the value of the resistor R will be



(a) 200 Ω (b) 100 Ω
(c) 500 Ω (d) 1000 Ω

45. When an unpolarized light of intensity I_0 is incident on a polarizing sheet, the intensity of the light which does not get transmitted is

(a) $\frac{1}{2} I_0$ (b) $\frac{1}{4} I_0$
(c) zero (d) I_0

46. When two tuning forks (fork 1 and fork 2) are sounded simultaneously, 4 beats per second are heard. Now, some tape is attached on the prong of the fork 2. When the tuning forks are sounded again, 6 beats per second are heard. If the frequency of fork 1 is 200 Hz, then what was the original frequency of fork 2 ?

(a) 200 Hz (b) 202 Hz
(c) 196 Hz (d) 204 Hz

47. An observer moves towards a stationary source of sound, with a velocity one-fifth of the velocity of sound. What is the percentage increase in the apparent frequency ?

(a) Zero (b) 0.5%
(c) 5% (d) 20%

48. A coil of inductance 300 mH and resistance 2Ω is connected to a source of voltage 2V. The current reaches half of its steady state value in

(a) 0.05 s (b) 0.1 s
(c) 0.15 s (d) 0.3 s

49. The refractive index of glass is 1.520 for red light and 1.525 for blue light. Let D_1 and D_2 be angles of minimum deviation for red and blue light respectively in a prism of this glass. then,

(a) $D_1 < D_2$
(b) $D_1 = D_2$
(c) D_1 can be less than or greater than D_2 depending upon the angle of prism
(d) $D_1 > D_2$

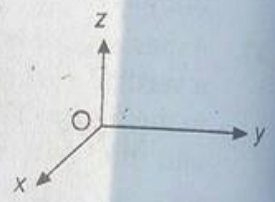
50. A particle of mass 100 g is thrown vertically upwards with a speed of 5 m/s. The work done by the force of gravity during the time the particle goes up is

(a) – 0.5 J (b) –1.25 J
(c) 1.25 J (d) 0.5 J

51. A mass of M kg is suspended by a weightless string. The horizontal force that is required to displace it until the string makes an angle of 45° with the initial vertical direction is

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

52. A force of $-F\,\hat{\mathbf{k}}$ acts on O, the origin of the coordinate system. The torque about the point $(1, -1)$ is



(a) $F\,(\hat{\mathbf{i}} - \hat{\mathbf{j}})$ (b) $-F(\hat{\mathbf{i}} + \hat{\mathbf{j}})$
(c) $F(\hat{\mathbf{i}} + \hat{\mathbf{j}})$ (d) $-F(\hat{\mathbf{i}} - \hat{\mathbf{j}})$

53. If M_O is the mass of an oxygen isotope ${}_8O^{17}$, M_p and M_n are the masses of a proton and a neutron, respectively, the nuclear binding energy of the isotope is

(a) $(M_O - 8M_p)c^2$
(b) $(M_O - 8M_p - 9M_n)c^2$
(c) $M_O c^2$
(d) $(M_O - 17M_n)c^2$

54. An electric charge 10^{-3} μC is placed at the origin (0, 0) of X-Y coordinate system. Two points A and B are situated at $(\sqrt{2}, \sqrt{2})$ and (2, 0) respectively. The potential difference between the points A and B will be

(a) 9 V (b) zero
(c) 2 V (d) 4.5 V

55. A sound absorber attenuates the sound level by 20 dB. The intensity decreases by a factor of

(b) 10000
(d) 100

of radius R is removed from a bigger circular disc of radius $2R$, such that the circumference of the discs coincide. The centre of mass of the new disc is αR from the centre of the bigger disc. The value of α is

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

(c) $\frac{1}{6}$ (d) $\frac{1}{4}$

57. Which of the following parameters does not characterise the thermodynamic state of matter?

(a) Temperature (b) Pressure

(c) Work (d) Volume

58. 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 $= 9.9 \times 10^{-15}$ 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

59. For a cubic crystal structure which one of the following relations indicating the cell characteristic is correct ?

(a) $a \neq b \neq c$ and $\alpha \neq \beta$ and $\gamma \neq 90°$

(b) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90°$

(c) $a = b = c$ and $\alpha \neq \beta \neq \gamma = 90°$

(d) $a = b = c$ and $\alpha = \beta = \gamma = 90°$

60. A common emitter amplifier has a voltage gain of 50, an input impedance of 100 Ω and an output impedance of 200 Ω. The power gain of the amplifier is

(a) 500 (b) 1000

(c) 1250 (d) 100

61. The phase difference between the instantaneous velocity and acceleration of a particle executing simple harmonic motion is

(a) 0.5π (b) π

(c) 0.707π (d) zero

62. A vertical spring with force constant k is fixed on a table. A ball of mass m at a height h above the free upper end of the spring falls vertically on the spring, so that the spring is compressed by a distance d. The net work done in the process is

(a) $mg(h + d) + \frac{1}{2} kd^2$ (b) $mg(h + d) - \frac{1}{2} kd^2$

(c) $mg(h - d) - \frac{1}{2} kd^2$ (d) $mg(h - d) + \frac{1}{2} kd^2$

63. Dimensions of resistance in an electrical circuit, in terms of dimension of mass M, of length L, of time T and of current I, would be

(a) $[ML^2T^{-3}I^{-1}]$ (b) $[ML^2T^{-2}]$

(c) $[ML^2T^{-1}I^{-1}]$ (d) $[ML^2T^{-3}I^{-2}]$

64. A particle moving along x-axis has acceleration f, at time t, given by $f = f_0\left(1 - \frac{t}{T}\right)$, where f_0 and T are constants. The particle at $t = 0$ has zero velocity. In the time interval between $t = 0$ and the instant when $f = 0$, the particle's velocity (v_x) is

(a) f_0T (b) $\frac{1}{2} f_0T^2$

(c) f_0T^2 (d) $\frac{1}{2} f_0T$

65. An alpha nucleus of energy $\frac{1}{2} mv^2$ bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to

(a) v^2 (b) $1/m$

(c) $1/v^4$ (d) $1/Ze$

66. The work of 146 kJ is performed in order to compress one kilo mole of a gas adiabatically and in this process the temperature of the gas increases by 7°C. The gas is ($R = 8.3\ J\ mol^{-1}\ K^{-1}$)

(a) diatomic

(b) triatomic

(c) a mixture of monoatomic and diatomic

(d) monoatomic

67. If g_E and g_M are the accelerations due to gravity on the surfaces of the earth and the moon respectively and if Millikan's oil drop experiment could be performed on the two surfaces, one will find the ratio $\frac{\text{electronic charge on the moon}}{\text{electronic charge on the earth}}$ to be

(a) 1 (b) zero

(c) $\frac{g_E}{g_M}$ (d) $\frac{g_M}{g_E}$

68. Diwali rocket is ejecting 50 g of gases/s at a velocity of 400 m/s. The accelerating force on the rocket will be

(b) 20 N
(d) 100 N

69. A frame made of metallic wire enclosing a surface area A is covered with a soap film. If the area of the frame of metallic wire is reduced by 50%, the energy of the soap film will be changed by
(a) 100% (b) 75%
(c) 50% (d) 25%

70. Mercury boils at 367°C. However, mercury thermometers are made such that they can measure temperature upto 500°C. This is done by
(a) maintaining vacuum above mercury column in the stem of the thermometer
(b) filling nitrogen gas at high pressure above the mercury column
(c) filling oxygen gas at high pressure above the mercury column
(d) filling nitrogen gas at low pressure above the mercury column

71. In a laboratory four convex lenses L_1, L_2, L_3 and L_4 of focal lengths 2, 4, 6 and 8 cm, respectively are available. Two of these lenses form a telescope of length 10 cm and magnifying power 4. The objective and eye lenses are respectively
(a) L_2, L_3 (b) L_1, L_4
(c) L_1, L_2 (d) L_4, L_1

72. A symmetric double convex lens is cut in two equal parts by a plane perpendicular to the principal axis. If the power of the original lens is 4D, the power of a cut lens will be
(a) 2D (b) 3D
(c) 4D (d) 5D

73. Two non-ideal batteries are connected in parallel. Consider the following statements.
(i) The equivalent emf is smaller than either of the two emfs.
(ii) The equivalent internal resistance is smaller than either of the two internal resistances.
(a) Both (i) and (ii) are correct
(b) (i) is correct but (ii) is wrong
(c) (ii) is correct but (i) is wrong
(d) Both (i) and (ii) are wrong

74. For a metallic wire, the ratio $\frac{V}{i}$ (V = applied potential difference and i = current flowing) is
(a) independent of temperature
(b) increases as the temperature rises
(c) decreases as the temperature rises
(d) increases or decreases as temperature rises depending upon the metal

75. The potential energy of a molecule on the surface of a liquid compared to one inside the liquid is
(a) zero (b) lesser
(c) equal (d) greater

Chemistry

1. How many unit cells are present in a cube shaped ideal crystal of NaCl of mass 1.00 g ? [Atomic masses : Na = 23, Cl = 35.5]
(a) 2.57×10^{21} (b) 5.14×10^{21}
(c) 1.28×10^{21} (d) 1.71×10^{21}

2. Graphite is a soft solid lubricant extremely difficult to melt. The reason for this anomalous behaviour is that, graphite
(a) is a non-crystalline substance
(b) is an allotropic form of diamond
(c) has molecules of variable molecular masses like polymers
(d) has carbon atoms arranged in large plates of rings of strongly bound carbon atoms with weak interplate bonds

3. When $CH_2{=}CH{-}COOH$ is reduced with $LiAlH_4$, the compound obtained will be
(a) $CH_3{-}CH_2{-}COOH$
(b) $CH_2{=}CH{-}CH_2OH$
(c) $CH_3{-}CH_2{-}CH_2OH$
(d) $CH_3{-}CH_2{-}CHO$

4. Which one of the following compounds has the smallest bond angle in its molecule ?
(a) SO_2 (b) OH_2
(c) SH_2 (d) NH_3

5. The solubility in water of a sparingly soluble salt AB_2 is 1.0×10^{-5} mol L^{-1}. Its solubility product number will be
(a) 4×10^{-15} (b) 4×10^{-10}
(c) 1×10^{-15} (d) 1×10^{-10}

reaction

$0.1\ M) \longrightarrow Zn^{2+}(1\ M) + Cu(s)$

taking place in a cell, E°_{cell} is 1.10 V. E_{cell} for the cell will be $\left(2.303\frac{RT}{F} = 0.0591\right)$

(a) 2.14 V (b) 1.80 V
(c) 1.07 V (d) 0.82 V

7. The rate law for a reaction between the substances A and B is given by rate $= k[A]^n[B]^m$ On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be as

(a) $\frac{1}{2^{m+n}}$ (b) $(m+n)$
(c) $(n-m)$ (d) $2^{(n-m)}$

8. If at 298 K the bond energies of C—H, C—C, C=C and H—H bonds are respectively 414, 347, 615 and 435 kJ mol^{-1}, the value of enthalpy change for the reaction

$H_2C{=}CH_2(g) + H_2(g) \longrightarrow H_3C{-}CH_3(g)$

at 298 K will be

(a) +250 kJ (b) −250 kJ
(c) +125 kJ (d) −125 kJ

9. For the reaction system,

$2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$

volume is suddenly reduced to half its value by increasing the pressure on it. If the reaction is of first order with respect to O_2 and second order with respect to NO; the rate of reaction will

(a) diminish to one-fourth of its initial value
(b) diminish to one-eighth of its initial value
(c) increase to eight times of its initial value
(d) increase to four times of its initial value

10. Which one of the following characteristics is not correct for physical adsorption ?

(a) Adsorption on solids is reversible
(b) Adsorption increases with increase in temperature
(c) Adsorption is spontaneous
(d) Both enthalpy and entropy of adsorption are negative

11. The correct order of increasing basic nature for the bases NH_3, CH_3NH_2 and $(CH_3)_2NH$ is

(a) $CH_3NH_2 < NH_3 < (CH_3)_2NH$
(b) $(CH_3)_2NH < NH_3 < CH_3NH_2$
(c) $NH_3 < CH_3NH_2 < (CH_3)_2NH$
(d) $CH_3NH_2 < (CH_3)_2NH < NH_3$

12. The solubilities of carbonates decrease dov the magnesium group due to a decrease in

(a) lattice energies of solids
(b) hydration energies of cations
(c) inter-ionic attraction
(d) entropy of solution formation

13. Nylon threads are made of

(a) polyvinyl polymer
(b) polyester polymer
(c) polyamide polymer
(d) polyethylene polymer

14. Due to the presence of an unpaired electr free radicals are

(a) cations
(b) anions
(c) chemically inactive
(d) chemically reactive

15. The highest electrical conductivity of following aqueous solutions is of

(a) 0.1 M difluoroacetic acid
(b) 0.1 M fluoroacetic acid
(c) 0.1 M chloroacetic acid
(d) 0.1 M acetic acid

16. Aluminium oxide may be electrolysed 1000°C to furnish aluminium metal (ato mass = 27 amu; 1 F = 96,500 C). The cath reaction is

$Al^{3+} + 3e^- \longrightarrow Al^0$

To prepare 5.12 kg of aluminium metal by this method would require

(a) 5.49×10^1 C of electricity
(b) 5.49×10^4 C of electricity
(c) 1.83×10^7 C of electricity
(d) 5.49×10^7 C of electricity

17. Consider the reaction

$N_2 + 3H_2 \longrightarrow 2NH_3$

carried out at constant temperature and pressure. If ΔH and ΔU are the enthalpy an internal energy changes for the reaction, which of the following expressions is true ?

(a) $\Delta H > \Delta U$ (b) $\Delta H < \Delta U$
(c) $\Delta H = \Delta U$ (d) $\Delta H = 0$

cular shapes of SF_4, CF_4 and XeF_4 are ent with 1, 0 and 2 lone pairs of electrons on the central atom, respectively
(b) different with 0, 1 and 2 lone pairs of electrons on the central atom, respectively
(c) the same with 1, 1 and 1 lone pair of electrons on the central atoms, respectively
(d) the same with 2, 0 and 1 lone pairs of electrons on the central atom, respectively

19. The lanthanide contraction is responsible for the fact that
(a) Zr and Zn have the same oxidation state
(b) Zr and Hf have about the same radius
(c) Zr and Nb have similar oxidation state
(d) Zr and Y have about the same radius

20. Calomel (Hg_2Cl_2) on reaction with ammonium hydroxide gives
(a) HgO
(b) Hg_2O
(c) $NH_2—Hg—Hg—Cl$
(d) $HgNH_2Cl$

21. Alkyl halides react with dialkyl copper reagents to give
(a) alkenyl halides
(b) alkanes
(c) alkyl copper halides
(d) alkenes

22. Acid catalyzed hydration of alkenes except ethene leads to the formation of
(a) mixture of secondary and tertiary alcohols
(b) mixture of primary and secondary alcohols
(c) secondary or tertiary alcohol
(d) primary alcohol

23. The structure of diborane (B_2H_6) contains
(a) four 2C-2e^- bonds and four 3C-2e^- bonds
(b) two 2C-2e^- bonds and two 3C-3e^- bonds
(c) two 2C-2e^- bonds and four 3C-2e^- bonds
(d) four 2C-2e^- bonds and two 3C-2e^- bonds

24. Reaction of cyclohexanone with dimethylamine in the presence of catalytic amount of an acid forms a compound of water during the reaction is continuously removed. The compound formed is generally known as
(a) an amine (b) an imine
(c) an enamine (d) a Schiff's base

25. An organic compound having molecular mass 60 is found to contain C = 20%, H = 6.67% and N = 46.67% while rest is oxygen. On heating it gives NH_3 alongwith a solid residue. The solid residue give violet colour with alkaline copper sulphate solution. The compound is
(a) $CH_3CH_2CONH_2$ (b) $(NH_2)_2CO$
(c) CH_3CONH_2 (d) CH_3NCO

26. 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

27. 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

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

29. 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) $K_c = \frac{1}{[O_2]^5}$

30. 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 adsorbed oxygen from electrode surfaces

31. 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

of the following ores is best by froth-floatation method ?

(b) Cassiterite
(c) Galena
(d) Malachite

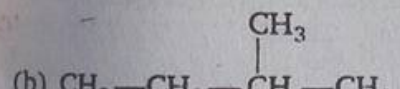
33. Excess of KI reacts with $CuSO_4$ solution and then $Na_2S_2O_3$ solution is added to it. Which of the statements is incorrect for this reaction ?
(a) Cu_2I_2 is formed
(b) CuI_2 is formed
(c) $Na_2S_2O_3$ is oxidised
(d) Evolved I_2 is reduced

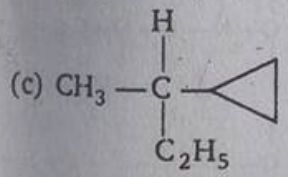
34. Which one of the following does not have sp^2 hybridised carbon ?
(a) Acetone
(b) Acetic acid
(c) Acetonitrile
(d) Acetamide

35. 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

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

(a) $CH_3—CH_2—CH_2—CH_3$

(b) 

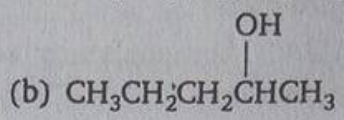
(c) 

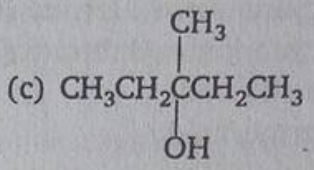
(d) $CH_3—CH_2—C\equiv CH$

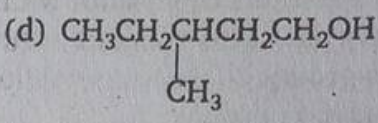
37. Consider the acidity of the carboxylic acids
(i) PhCOOH
(ii) o-$NO_2C_6H_4COOH$
(iii) p-$NO_2C_6H_4COOH$
(iv) m-$NO_2C_6H_4COOH$
Which of the following order is correct ?
(a) (i) > (ii) > (iii) > (iv)
(b) (ii) > (iv) > (iii) > (i)
(c) (ii) > (iv) > (i) > (iii)
(d) (ii) > (iii) > (iv) > (i)

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

39. Among the following compounds which can be dehydrated very easily ?
(a) $CH_3CH_2CH_2CH_2CH_2OH$

(b) 

(c) 

(d) 

40. 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

41. The radioisotope, tritium (^3_1H) has a half-life of 12.3 yr. If the initial amount of tritium is 32 mg, how many milligrams of it would remain after 49.2 yr ?
(a) 4 mg
(b) 8 mg
(c) 1 mg
(d) 2 mg

42. In this reaction

$$CH_3CHO + HCN \longrightarrow CH_3CH(OH)CN \xrightarrow{H\cdot OH} CH_3CH(OH)COOH$$

an asymmetric centre is generated. The acid obtained would be
(a) 50% D + 50% L-isomer
(b) 20% D +80% L-isomer
(c) D-isomer
(d) L-isomer

43. Which one of the following octahedral complexes will not show geometrical isomerism ? (A and B are monodentate ligands)
(a) $[MA_4B_2]$
(b) $[MA_5B]$
(c) $[MA_2B_4]$
(d) $[MA_3B_3]$

44. The method of zone refining of metals is based on the principle of
(a) greater noble character of the solid metal than that of the impurity

ter solubility of the impurity in the
en state than in the solid
ter mobility of the pure metal than that of impurity
(d) higher melting point of the impurity than that of the pure metal

45. According to IUPAC nomenclature sodium nitroprusside is named as
(a) sodium pentacyanonitrosyl ferrate (II)
(b) sodium pentacyanonitrosyl ferrate (III)
(c) sodium nitroferricyanide
(d) sodium nitroferrocyanide

46. Phospholipids are esters of glycerol with
(a) one carboxylic acid residue and two phosphate groups
(b) three phosphate groups
(c) three carboxylic acid residues
(d) two carboxylic acid residues and one phosphate groups

47. The temperature dependence of rate constant (k) of a chemical reaction is written in terms of Arrhenius equation, $k = Ae^{-E^*/RT}$. Activation energy (E^*) of the reaction can be calculated by ploting
(a) $\log k$ vs $\frac{1}{T}$ (b) $\log k$ vs $\frac{1}{\log T}$
(c) k vs T (d) k vs $\frac{1}{\log T}$

48. In a set of the given reactions, acetic acid yielded a product C.

$$CH_3COOH + PCl_5 \longrightarrow A$$

$$A \xrightarrow[\text{anh. } AlCl_3]{C_6H_6} B \xrightarrow[\text{ether}]{C_2H_5MgBr} C$$

Product C would be
(a) $CH_3CH(OH)C_6H_5$
(b) $CH_3-\underset{\displaystyle C_2H_5}{\overset{|}{C}}(OH)C_6H_5$
(c) $CH_3CH(OH)C_2H_5$
(d) $CH_3COC_6H_5$

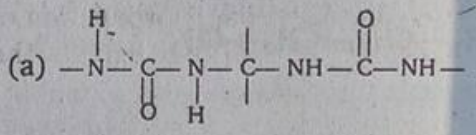
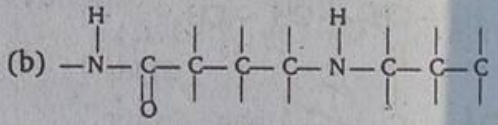
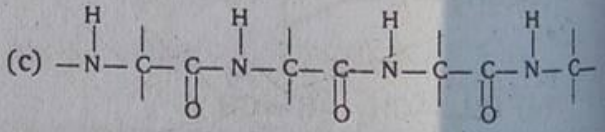
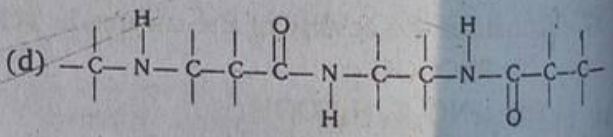
49. The correct order of ionic radii of Y^{3+}, La^{3+}, Eu^{3+} and Lu^{3+} is
(a) $Lu^{3+} < Eu^{3+} < La^{3+} < Y^{3+}$
(b) $La^{3+} < Eu^{3+} < Lu^{3+} < Y^{3+}$
(c) $Y^{3+} < La^{3+} < Eu^{3+} < Lu^{3+}$
(d) $Y^{3+} < Lu^{3+} < Eu^{3+} < La^{3+}$

(Atomic no. Y = 39, La = 57, Eu = 63, Lu = 71)

50. Which one of the following compounds, is not a protonic acid ?
(a) $SO(OH)_2$ (b) $SO_2(OH)_2$
(c) $B(OH)_3$ (d) $PO(OH)_3$

51. Formation of a solution from two components can be considered as
(1) pure solvent → separated solvent molecules, ΔH_1
(2) pure solute → separated solute molecules, ΔH_2
(3) separated solvent and solute molecules → solution, ΔH_3
Solution so formed will be ideal if
(a) $\Delta H_{soln} = \Delta H_1 - \Delta H_2 - \Delta H_3$
(b) $\Delta H_{soln} = \Delta H_3 - \Delta H_1 - \Delta H_2$
(c) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 + \Delta H_3$
(d) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 - \Delta H_3$

52. Among the following, the pair in which the two species are not isostructural, is
(a) SiF_4 and SF_4 (b) IO_3^- and XeO_3
(c) BH_4^- and NH_4^+ (d) PF_6^- and SF_6

53. Which one of the following structures represents the peptide chain ?
(a)

(b)

(c)

(d)


54. The maximum number of molecule is present in
(a) 15 L of H_2 gas at STP
(b) 5 L of N_2 gas at STP
(c) 0.5 g of H_2 gas
(d) 10 g of O_2 gas

55. A sequence of how many nucleotides in messenger RNA makes a codon for an amino acid ?
(a) Three (b) Four
(c) One (d) Two

proportional to effective nuclear

(b) inversely proportional to square of effective nuclear charge

(c) directly proportional to effective nuclear charge

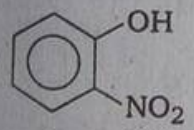
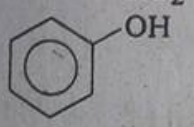
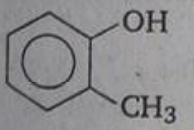
(d) directly proportional to square of effective nuclear charge

57. The helical structure of protein is stabilized by
(a) dipeptide bonds (b) hydrogen bonds
(c) ether bonds (d) peptide bonds

58. The radioactive isotope $^{60}_{27}Co$ which is used in the treatment of cancer can be made by (n, p) reaction. For this reaction the target nucleus is
(a) $^{59}_{28}Ni$ (b) $^{59}_{27}Co$
(c) $^{60}_{28}Ni$ (d) $^{60}_{27}Co$

59. The work done during the expansion of a gas from a volume of 4 dm^3 to 6 dm^3 against a constant external pressure of 3 atm, is
(a) –6 J (b) –608 J
(c) +304 J (d) –304 J

60. The mass of carbon anode consumed (giving only carbon dioxide) in the production of 270 kg of aluminium metal from bauxite by the Hall process is
(Atomic mass of Al = 27)
(a) 180 kg (b) 270 kg
(c) 540 kg (d) 90 kg

61. Which one of the following compounds, is most acidic ?
(a) $Cl—CH_2—CH_2—OH$
(b) 
(c) 
(d) 

62. The vapour pressure of two liquids P and Q are 80 and 60 torr, respectively. The total vapour pressure of solution obtained by mixing 3 moles of P and 2 moles of Q would be
(a) 140 torr (b) 20 torr
(c) 68 torr (d) 72 torr

63. Which functional group participates in disulphide bond formation in proteins ?
(a) Thiolacetone (b) Thiol
(c) Thioether (d) Thioester

64. The energy of second Bohr orbit of the hydrogen atom is –328 kJ mol^{-1}; hence the energy of fourth Bohr orbit would be
(a) –41 kJ mol^{-1} (b) –1312 kJ mol^{-1}
(c) –164 kJ mol^{-1} (d) –82 kJ mol^{-1}

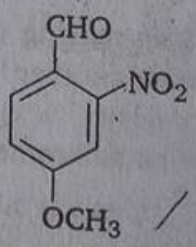
65. Which one of the following arrangements represents the correct order of electron gain enthalpy (with negative sign) of the given atomic species ?
(a) Cl < F < S < O (b) O < S < F< Cl
(c) S < O < Cl < F (d) F < Cl < O< S

66. Which of the following is responsible for depletion of the ozone layer in the upper strata of the atmosphere ?
(a) Polyhalogens (b) Ferrocenes
(c) Fullerenes (d) Freons

67. What amount of bromine will be required to convert 2 g of phenol into 2, 4, 6-bribromo phenol ?
(a) 20.44 g (b) 6.00 g
(c) 4.00 g (d) 10.22 g

68. Isomers of propionic acid are
(a) $HCOOC_2H_5$ and CH_3COOCH_3
(b) $HCOOC_2H_5$ and C_3H_7COOH
(c) CH_3COOCH_3 and C_3H_7OH
(d) C_3H_7OH and CH_3COCH_3

69. Metamers of ethyl propionate are
(a) C_4H_9COOH and $HCOOC_4H_9$
(b) C_4H_9COOH and $CH_3COOC_3H_7$
(c) CH_3COOCH_3 and $CH_3COOC_3H_7$
(d) $CH_3COOC_3H_7$ and $C_3H_7COOCH_3$

70. What is the correct IUPAC name of

?
(a) 4-methoxy-2-nitrobenzaldehyde
(b) 4-formyl-3-nitro anisole
(c) 4-methoxy-6-nitrobenzaldehyde
(d) 2-formyl-5-methoxy nitrobenzene

the following is anhydride of id ?

(a) Cl_2O_7 (b) Cl_2O_5
(c) Cl_2O_3 (d) HClO

72. The concentration of H_2O_2 solution of '10 volume' is
(a) 30% (b) 3%
(c) 1% (d) 10%

73. The dipole moment of HBr is 1.6×10^{-30} cm and inter-atomic spacing is 1 Å. The % ionic character of HBr is
(a) 7 (b) 10
(c) 15 (d) 27

74. $CaC_2 + N_2 \longrightarrow A$, product A is
(a) $CaCN_2$ (b) $CaCN_2$ and C
(c) $CaCN_2 + N_2$ (d) none of these

75. The safest and the most common alternative of sugar is
(a) glucose (b) aspartame
(c) saccharin (d) cyclodextrin

Mathematics

1. If $\vec{a}$ is perpendicular to $\vec{b}$ and $\vec{c}$, $|\vec{a}| = 2$, $|\vec{b}| = 3$, $|\vec{c}| = 4$ and the angle between $\vec{b}$ and $\vec{c}$ is $\frac{2\pi}{3}$, then $[\vec{a}\,\vec{b}\,\vec{c}]$ is equal to
(a) $4\sqrt{3}$ (b) $6\sqrt{3}$
(c) $12\sqrt{3}$ (d) $18\sqrt{3}$

2. The general solution of $y^2\,dx + (x^2 - xy + y^2)\,dy = 0$ is
(a) $\tan^{-1}\left(\frac{x}{y}\right) + \log y + c = 0$
(b) $2\tan^{-1}\left(\frac{x}{y}\right) + \log x + c = 0$
(c) $\log\left(y + \sqrt{x^2 + y^2}\right) + \log y + c = 0$
(d) $\sinh^{-1}\left(\frac{x}{y}\right) + \log y + c = 0$

3. The vector $\hat{i} + x\hat{j} + 3\hat{k}$ is rotated through an angle θ and doubled in magnitude, then it becomes $4\hat{i} + (4x - 2)\hat{j} + 2\hat{k}$. The value of x is
(a) $\left\{-\frac{2}{3}, 2\right\}$ (b) $\left\{\frac{1}{3}, 2\right\}$
(c) $\left\{\frac{2}{3}, 0\right\}$ (d) $\{2, 7\}$

4. A ball of mass 3 kg moving with a velocity of 3 m/s collides with another ball of mass 1 kg moving with velocity u in the opposite direction. If the first ball comes to rest after the impact and $e = \frac{2}{7}$, then u is in m/s, is
(a) $\frac{13}{3}$ (b) $\frac{17}{3}$
(c) $\frac{19}{3}$ (d) $\frac{23}{3}$

5. Three forces of magnitude 30, 60 and P acting at a point are in equilibrium. If the angle between the first two is 60°, the value of P is
(a) $30\sqrt{7}$ (b) $30\sqrt{3}$
(c) $20\sqrt{6}$ (d) $25\sqrt{2}$

6. Let $\vec{a}$ and $\vec{b}$ be two equal vectors inclined at an angle θ, then $a \sin\frac{\theta}{2}$ is equal to
(a) $\frac{|\vec{a} - \vec{b}|}{2}$ (b) $\frac{|\vec{a} + \vec{b}|}{2}$
(c) $|\vec{a} - \vec{b}|$ (d) $|\vec{a} + \vec{b}|$

7. The solution of the equation $\frac{d^2y}{dx^2} = e^{-2x}$ is
(a) $y = \frac{1}{4}e^{-2x} + \frac{cx}{2} + d$
(b) $y = \frac{1}{4}e^{-2x} + cx + d$
(c) $y = \frac{1}{4}e^{-2x} + cx^2 + d$
(d) $y = \frac{1}{4}e^{-2x} + cx^3 + d$

8. $\int \frac{dx}{x^2 + 4x + 13}$ is equal to
(a) $\log(x^2 + 4x + 13) + c$
(b) $\frac{1}{3}\tan^{-1}\left(\frac{x+2}{3}\right) + c$
(c) $\log(2x + 4) + c$
(d) $\frac{2x + 4}{(x^2 + 4x + 13)^2} + c$

f $\int_2^3 \frac{x+1}{x^2(x-1)}\,dx$ is

(a) $\log \frac{9}{} + \frac{1}{6}$ (b) $\log \frac{16}{9} - \frac{1}{6}$

(c) $2\log 2 - \frac{1}{6}$ (d) $\log \frac{4}{3} - \frac{1}{6}$

10. $\int_0^{\pi/4} (\cos x - \sin x)\,dx + \int_{\pi/4}^{5\pi/4} (\sin x - \cos x)\,dx + \int_{2\pi}^{\pi/4} (\cos x - \sin x)\,dx$ is equal to

(a) $\sqrt{2} - 2$ (b) $2\sqrt{2} - 2$

(c) $3\sqrt{2} - 2$ (d) $4\sqrt{2} - 2$

11. The length of the chord of the parabola $x^2 = 4y$ passing through the vertex and having slope $\cot \alpha$ is

(a) $4 \cos \alpha \operatorname{cosec}^2 \alpha$ (b) $4 \tan \alpha \sec \alpha$

(c) $4 \sin \alpha \sec^2 \alpha$ (d) none of these

12. Equation of tangents to the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$, which are perpendicular to the line $3x + 4y = 7$, are

(a) $4x - 3y = \pm \sqrt{20}$ (b) $4x - 3y = \pm \sqrt{12}$

(c) $4x - 3y = \pm \sqrt{2}$ (d) $4x - 3y = \pm 1$

13. From the point $P(16, 7)$ tangents PQ and PR are drawn to the circle $x^2 + y^2 - 2x - 4y - 20 = 0$. If c be the centre of the circle, then area of quadrilateral $PQCR$ is

(a) 450 sq unit (b) 15 sq unit

(c) 50 sq unit (d) 75 sq unit

14. The distance between the lines $3x + 4y = 9$ and $6x + 8y = 15$ is

(a) $\frac{3}{2}$ (b) $\frac{3}{10}$

(c) 6 (d) none of these

15. If $\tan x = \frac{b}{a}$, then the value of $a \cos 2x + b \sin 2x$ is

(a) a (b) $a - b$

(c) $a + b$ (d) b

16. The maximum value of $3 \cos \theta + 4 \sin \theta$ is

(a) 3 (b) 4

(c) 5 (d) none of these

17. In a triangle ABC, right angled at C, the value of $\cot A + \cot B$ is

(a) $\frac{c^2}{ab}$ (b) $a + b$

(c) $\frac{a^2}{bc}$ (d) $\frac{b^2}{ac}$

18. The records of a hospital show that 10% of the cases of a certain disease are fatal. If 6 patients are suffering from the disease, then the probability that only three will die, is

(a) 8748×10^{-5} (b) 1458×10^{-5}

(c) 1458×10^{-6} (d) 41×10^{-6}

19. Out of 40 consecutive natural numbers, two are chosen at random. Probability that the sum of the number is odd, is

(a) $\frac{14}{29}$ (b) $\frac{20}{39}$

(c) $\frac{1}{2}$ (d) none of these

20. If $\arg(z) = \theta$, then $\arg(\bar{z})$ is equal to

(a) $\theta - \pi$ (b) $\pi - \theta$

(c) 0 (d) $-\theta$

21. If z is a complex number such that $\frac{z-1}{z+1}$ is purely imaginary, then $|z|$ is equal to

(a) 0 (b) 1

(c) $\sqrt{2}$ (d) none of these

22. If α, β are the roots of the equation $lx^2 + mx + n = 0$, then the equation whose roots are $\alpha^3\beta$ and $\alpha\beta^3$, is

(a) $l^4x^2 - nl(m^2 - 2nl)x + n^4 = 0$

(b) $l^4x^2 + nl(m^2 - 2nl)x + n^4 = 0$

(c) $l^4x^2 + nl(m^2 - 2nl)x - n^4 = 0$

(d) $l^4x^2 - nl(m^2 + 2nl)x + n^4 = 0$

23. If the 7th term of a HP is $\frac{1}{10}$ and the 12th term is $\frac{1}{25}$, then the 20th term is

(a) $\frac{1}{41}$ (b) $\frac{1}{45}$

(c) $\frac{1}{49}$ (d) $\frac{1}{37}$

24. The value of $2^{1/4} \cdot 4^{1/8} \cdot 8^{1/16} \cdot 16^{1/32} \ldots$

(a) $\frac{3}{2}$ (b) $\frac{5}{2}$

(c) 2 (d) 1

25. Out of 6 boys and 4 girls, a group of 7 is to be formed. In how many ways can this be done, if the group is to have a majority of boys?

(b) 80
(d) 100

26. $\begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix} [2\ 1\ -1]$ is equal to

(a) $\begin{bmatrix} 2 \\ -1 \\ -2 \end{bmatrix}$ (b) $\begin{bmatrix} 2 & 1 & -1 \\ -2 & -1 & 1 \\ 4 & 2 & -2 \end{bmatrix}$

(c) $[-1]$ (d) not defined

27. The domain of the function $\sin^{-1}\left(\log_2 \frac{x^2}{2}\right)$ is

(a) $[-1, 2] - \{0\}$ (b) $[-2, 2] - (-1, 1)$

(c) $[-2, 2] - \{0\}$ (d) $[1, 2]$

28. $\lim_{x \to \infty} \frac{(2x-3)(3x-4)}{(4x-5)(5x-6)}$ is equal to

(a) $\frac{1}{10}$ (b) 0

(c) $\frac{1}{5}$ (d) $\frac{3}{10}$

29. Function $f(x) = \begin{cases} x-1, & x < 2 \\ 2x-3, & x \geq 2 \end{cases}$ is a continuous function

(a) for $x = 2$ only

(b) for all real values of x such that $x \neq 2$

(c) for all real values of x

(d) for all integral values of x only

30. Differential coefficient of $\sqrt{\sec \sqrt{x}}$ is

(a) $\frac{1}{4\sqrt{x}} \sec \sqrt{x} \sin \sqrt{x}$

(b) $\frac{1}{4\sqrt{x}} (\sec \sqrt{x})^{3/2} \cdot \sin \sqrt{x}$

(c) $\frac{1}{2} \sqrt{x} \sec \sqrt{x} \sin \sqrt{x}$

(d) $\frac{1}{2} \sqrt{x} (\sec \sqrt{x})^{3/2} \cdot \sin \sqrt{x}$

31. The function $x^5 - 5x^4 + 5x^3 - 1$ is

(a) neither maximum nor minimum at $x = 0$

(b) maximum at $x = 0$

(c) maximum at $x = 1$ and minimum at $x = 3$

(d) minimum at $x = 0$

32. If $x = y\sqrt{1-y^2}$, then $\frac{dy}{dx}$ is equal to

(a) x (b) $\frac{\sqrt{1-y^2}}{1+2y^2}$

(c) $\frac{\sqrt{1-y^2}}{1-2y^2}$ (d) 0

33. If the planes $x + 2y + kz = 0$ and $2x + y - 2z = 0$, are at right angles, then the value of k is

(a) 2 (b) -2

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

34. The ratio in which the line joining $(2, 4, 5)$, $(3, 5, -4)$ is divided by the yz-plane is

(a) 2 : 3 (b) 3 : 2

(c) $-2 : 3$ (d) 4 : -3

35. The radical centre of the circles

$x^2 + y^2 - 16x + 60 = 0$,

$x^2 + y^2 - 12x + 27 = 0$

and $x^2 + y^2 - 12y + 8 = 0$ is

(a) $\left(13, \frac{33}{4}\right)$ (b) $\left(\frac{33}{4}, -13\right)$

(c) $\left(\frac{33}{4}, 13\right)$ (d) none of these

36. If the lines $3x + 4y + 1 = 0$, $5x + \lambda y + 3 = 0$ and $2x + y - 1 = 0$ are concurrent, then λ is equal to

(a) -8 (b) 8

(c) 4 (d) -4

37. $\int \frac{a^{x/2}}{\sqrt{a^{-x} - a^x}} dx$ is equal to

(a) $\frac{1}{\log a} \sin^{-1}(a^x) + c$

(b) $\frac{1}{\log a} \tan^{-1}(a^x) + c$

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

(d) $\log(a^x - 1) + c$

38. The value of $\int_0^1 \frac{x^4 + 1}{x^2 + 1} dx$ is

(a) $\frac{1}{6}(3 - 4\pi)$ (b) $\frac{1}{6}(3\pi + 4)$

(c) $\frac{1}{6}(3 + 4\pi)$ (d) $\frac{1}{6}(3\pi - 4)$

39. The solution of the differential equation $\frac{dy}{dx} = y \tan x - 2 \sin x$, is

(a) $y \sin x = c + \sin 2x$

(b) $y \cos x = c + \frac{1}{2} \sin 2x$

(c) $y \cos x = c - \sin 2x$

(d) $y \cos x = c + \frac{1}{2} \cos 2x$

1) and $\vec{b} = (-2, m)$ are two collinear n m is equal to

(b) 4
(c) 3 (d) 0

41. A ball falls from rest from top of a tower. If the ball reaches the foot of the tower in 3 s, then height of tower is (take $g = 10\ m/s^2$)
(a) 45 m (b) 50 m
(c) 40 m (d) none of these

42. A particle is thrown vertically upwards with a velocity of 490 cm/s. It will return to this position after
(a) 1 s (b) 0.5 s
(c) 2 s (d) none of these

43. The resultant of two forces P and $2P$ is $P\sqrt{3}$. If Ist force is doubled and reversed, the resultant of forces is
(a) $2P\sqrt{3}$ (b) $P\sqrt{3}$
(c) $4P$ (d) none of these

44. The value of
$$1 - \log 2 + \frac{(\log 2)^2}{2!} - \frac{(\log 2)^3}{3!} + \ldots \text{ is}$$
(a) $\log 3$ (b) $\log 2$
(c) $\frac{1}{2}$ (d) none of these

45. The maximum value of $f(x) = \frac{x}{4 + x + x^2}$ on $[-1, 1]$ is
(a) $-\frac{1}{3}$ (b) $-\frac{1}{4}$
(c) $\frac{1}{5}$ (d) $\frac{1}{6}$

46. $\int \frac{e^x}{(2 + e^x)(e^x + 1)}\, dx$ is equal to
(a) $\log\left(\frac{e^x + 1}{e^x + 2}\right) + c$ (b) $\log\left(\frac{e^x + 2}{e^x + 1}\right) + c$
(c) $\left(\frac{e^x + 1}{e^x + 2}\right) + c$ (d) $\left(\frac{e^x + 2}{e^x + 1}\right) + c$

47. If the radius of a circle be increasing at a uniform rate of 2 cm/s. The area of increasing of area of circle, at the instant when the radius is 20 cm, is
(a) $70\pi\ cm^2/s$ (b) $70\ cm^2/s$
(c) $80\pi\ cm^2/s$ (d) $80\ cm^2/s$

48. 5 boys and 5 girls are sitting in a row randomly. The probability that boys and girls sit alternatively, is
(a) $\frac{5}{126}$ (b) $\frac{1}{42}$
(c) $\frac{4}{126}$ (d) $\frac{1}{126}$

49. If $P(A) = P(B) = x$ and $P(A \cap B) = P(A' \cap B') = \frac{1}{3}$, then x is equal to
(a) $\frac{1}{2}$ (b) $\frac{1}{3}$
(c) $\frac{1}{4}$ (d) $\frac{1}{6}$

50. The focus of the parabola $y^2 - x - 2y + 2 = 0$ is
(a) $\left(\frac{1}{4}, 0\right)$ (b) $(1, 2)$
(c) $\left(\frac{5}{4}, 1\right)$ (d) $\left(\frac{3}{4}, \frac{5}{2}\right)$

51. The equation of normal at the point $(0, 3)$ of the ellipse $9x^2 + 5y^2 = 45$ is
(a) x-axis (b) y-axis
(c) $y + 3 = 0$ (d) $y - 3 = 0$

52. The equation of the tangent parallel to $y - x + 5 = 0$ drawn to $\frac{x^2}{3} - \frac{y^2}{2} = 1$ is
(a) $x - y + 1 = 0$ (b) $x - y + 2 = 0$
(c) $x + y - 1 = 0$ (d) $x + y + 2 = 0$

53. Let the functions f, g, h are defined from the set of real numbers R to R such that $f(x) = x^2 - 1$, $g(x) = \sqrt{(x^2 + 1)}$ and
$$h(x) = \begin{cases} 0, & \text{if } x < 0 \\ x, & \text{if } x \geq 0 \end{cases}$$
then $ho(fog)(x)$ is defined by
(a) x (b) x^2
(c) 0 (d) none of these

54. The angle of elevation of the sun, if the length of the shadow of a tower is $\sqrt{3}$ times the height of the pole, is
(a) 150° (b) 30°
(c) 60° (d) 45°

55. If $\sin A = n \sin B$, then $\frac{n-1}{n+1} \tan \frac{A+B}{2}$ is equal to
(a) $\sin \frac{A-B}{2}$ (b) $\tan \frac{A-B}{2}$
(c) $\cot \frac{A-B}{2}$ (d) none of these

roots of the given equation
$(x-b)+(x-b)(x-c)$
$+(x-c)(x-a)=0$
are always
(a) positive (b) negative
(c) real (d) imaginary

57. $3\tan^{-1}a$ is equal to
(a) $\tan^{-1}\frac{3a+a^3}{1+3a^2}$ (b) $\tan^{-1}\frac{3a-a^3}{1+3a^2}$
(c) $\tan^{-1}\frac{3a+a^3}{1-3a^2}$ (d) $\tan^{-1}\frac{3a-a^3}{1-3a^2}$

58. In which quadrant of the complex plane, the point $\frac{1+2i}{1-i}$ lies?
(a) Fourth (b) First
(c) Second (d) Third

59. The argument of the complex number $\frac{13-5i}{4-9i}$ is
(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{5}$ (d) $\frac{\pi}{6}$

60. If $\sin\alpha$ and $\cos\alpha$ are the roots of the equation $px^2+qx+r=0$, then
(a) $p^2+q^2-2pr=0$ (b) $p^2-q^2+2pr=0$
(c) $p^2-q^2-2pr=0$ (d) $p^2+q^2+2qr=0$

61. If a, b, c are in GP, then the equations $ax^2+2bx+c=0$ and $dx^2+2ex+f=0$ have a common root, if $\frac{d}{a}, \frac{e}{b}, \frac{f}{c}$ are in
(a) AP (b) GP
(c) HP (d) none of these

62. The sum of 24 terms of the following series $\sqrt{2}+\sqrt{8}+\sqrt{18}+\sqrt{32}+\ldots$ is
(a) 300 (b) $300\sqrt{2}$
(c) $200\sqrt{2}$ (d) none of these

63. $x=0$, the function $f(x)=|x|$ is
(a) continuous but not differentiable
(b) discontinuous and differentiable
(c) discontinuous and not differentiable
(d) continuous and differentiable

64. In the expansion of $\left(2x^2-\frac{1}{x}\right)^{12}$, the term independent of x is
(a) 8th (b) 7th
(c) 9th (d) 10th

65. The general value of θ in the equation $\cos\theta=\frac{1}{\sqrt{2}}$, $\tan\theta=-1$ is
(a) $2n\pi\pm\frac{\pi}{6}, n\in I$ (b) $2n\pi+\frac{7\pi}{4}, n\in I$
(c) $n\pi+(-1)^n\frac{\pi}{3}, n\in I$ (d) $n\pi+(-1)^n\frac{\pi}{4}, n\in I$

66. In a ΔABC, if $r_1=2r_2=3r_3$, then
(a) $\frac{a}{b}=\frac{4}{5}$ (b) $\frac{a}{b}=\frac{5}{4}$
(c) $a+b-2c=0$ (d) $2a=b+c$

67. If $A=\begin{bmatrix}1 & 2\\ 3 & -5\end{bmatrix}$, then A^{-1} is equal to
(a) $\begin{bmatrix}-5 & -2\\ -3 & 1\end{bmatrix}$ (b) $\begin{bmatrix}5/11 & 2/11\\ 3/11 & -1/11\end{bmatrix}$
(c) $\begin{bmatrix}-5/11 & -2/11\\ -3/11 & -1/11\end{bmatrix}$ (d) $\begin{bmatrix}5 & 2\\ 3 & -1\end{bmatrix}$

68. The range of $f(x)=\cos x-\sin x$ is
(a) $[-1, 1]$ (b) $(-1, 2)$
(c) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ (d) $[-\sqrt{2}, \sqrt{2}]$

69. The value of $\lim_{x\to\infty}\left(\frac{x^2+bx+4}{x^2+ax+5}\right)$ is
(a) $\frac{b}{a}$ (b) 0
(c) 1 (d) $\frac{4}{5}$

70. Let $f(x)=\begin{cases}\frac{\sin\pi x}{5x}, & x\neq 0\\ k, & x=0\end{cases}$, if $f(x)$ is continuous at $x=0$, then k is equal to
(a) $\frac{\pi}{5}$ (b) $\frac{5}{\pi}$
(c) 1 (d) 0

71. If θ be the angle between the vectors $\vec{a}=2\hat{i}+2\hat{j}-\hat{k}$ and $\vec{b}=6\hat{i}-3\hat{j}+2\hat{k}$, then
(a) $\cos\theta=\frac{4}{21}$ (b) $\cos\theta=\frac{3}{19}$
(c) $\cos=\frac{2}{19}$ (d) $\cos\theta=\frac{5}{21}$

72. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be vectors with magnitudes 3, 4 and 5 respectively and $\vec{a}+\vec{b}+\vec{c}=\vec{0}$, then the values of $\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}$ is
(a) 47 (b) 25
(c) 50 (d) −25

s moving in a straight line with
city. Its acceleration is

(a) positive (b) negative
(c) zero (d) none of these

74. If a particle is projected with a velocity 49 m/s making an angle 60° with the horizontal, its time of flight is

(a) $10\sqrt{3}$ s (b) $5\sqrt{3}$ s
(c) $\sqrt{3}$ s (d) none of these

75. If two equal components (P) of a force (F) a acting at an angle 120°, then F is

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

ANSWERS

PHYSICS

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

CHEMISTRY

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

MATHEMATICS

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