WARNING :	Any malpractice or any attempt to commit any kind of malpractice in the Examination will DISQUALIFY THE CANDIDATE.

PAPER – I PHYSICS & CHEMISTRY

Version Code		Question Booklet Serial Number	
Time : 150 Minutes		Number of Questions : 120	Maximum Marks : 480
Name of Candidate			
Roll Number			
Signature of Candidate			

INSTRUCTIONS TO THE CANDIDATE

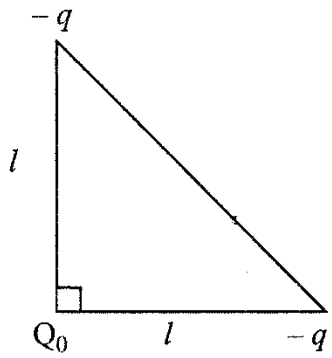
1. Please ensure that the **VERSION CODE shown at the top of this Question Booklet is the same as that shown in the OMR Answer Sheet issued to you.** If you have received a Question Booklet with a different **VERSION CODE**, please get it replaced with a Question Booklet with the same VERSION CODE as that of the OMR Answer Sheet from the Invigilator. **THIS IS VERY IMPORTANT.**
2. Please fill in the items such as name, signature and roll number of the candidate in the columns given above. Please also write the Question Booklet Sl. No. given at the top of this page against item 4 in the OMR Answer Sheet.
3. Please read the instructions given in the OMR Answer Sheet for marking answers. Candidates are advised to strictly follow the instructions contained in the OMR Answer Sheet.
4. This Question Booklet contains 120 Questions. For each Question, five answers are suggested and given against (A), (B), (C), (D) and (E) of which, only one will be the **Most Appropriate Answer**. Mark the bubble containing the letter corresponding to the 'Most Appropriate Answer' in the OMR Answer Sheet, by using either **Blue or Black ball - point pen only.**
5. Negative Marking: In order to discourage wild guessing, the score will be subject to penalization formula based on the number of right answers actually marked and the number of wrong answers marked. Each correct answer will be awarded FOUR marks. One mark will be deducted for each incorrect answer. More than one answer marked against a question will be deemed as incorrect answer and will be negatively marked.

IMMEDIATELY AFTER OPENING THIS QUESTION BOOKLET, THE CANDIDATE SHOULD VERIFY WHETHER THE QUESTION BOOKLET ISSUED CONTAINS ALL THE 120 QUESTIONS IN SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT.

DO NOT OPEN THE SEAL UNTIL THE INVIGILATOR ASKS YOU TO DO SO

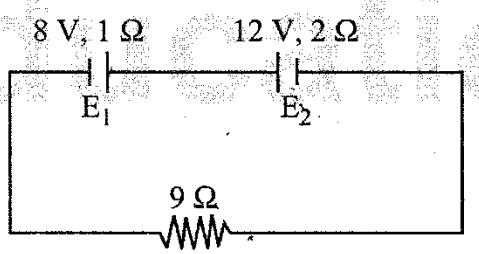
PLEASE ENSURE THAT THIS BOOKLET CONTAINS 120 QUESTIONS SERIALLY NUMBERED FROM 1 TO 120 (Printed Pages : 32)

1. Three charges Q_0, $-q$ and $-q$ are placed at the vertices of an isosceles right angled triangle as in the figure. The net electrostatic potential energy is zero if Q_0 is equal to



(A) $\frac{q}{4}$ (B) $\frac{2q}{\sqrt{32}}$ (C) $\sqrt{2q}$ (D) $+q$ (E) $\frac{q}{\sqrt{2}}$

2. In the figure shown below, the terminal voltage across E_2 is



(A) 12 V (B) 12.66 V (C) 11.34 V (D) 11.66 V (E) 12.33 V

3. The drift velocity of the electrons in a copper wire of length 2 m under the application of a potential difference of 200 V is 0.5 ms^{-1}. Their mobility is (in $m^2\ V^{-1}\ s^{-1}$)

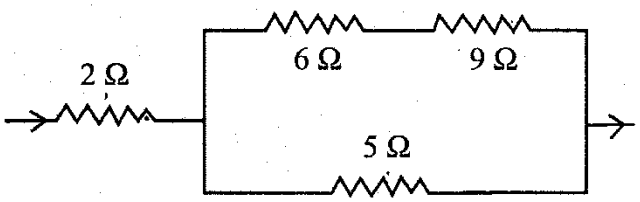
(A) 2.5×10^{-3} (B) 2.5×10^{-2} (C) 5×10^{2}
(D) 5×10^{-3} (E) 5×10^{-2}

4. When two resistances R_1 and R_2 are connected in series, they consume 12 W power. When they are connected in parallel, they consume 50 W power. What is the ratio of the powers of R_1 and R_2?

(A) $\frac{1}{4}$ (B) 4 (C) $\frac{3}{2}$ (D) 3 (E) 1

(Space for Rough Work)

5. In the circuit shown, if the resistance 5 Ω develops a heat of 42 J per second, the heat developed in 2 Ω must be about (in Js^{-1})



(A) 25 (B) 20 (C) 30 (D) 35 (E) 40

6. When a Daniel cell is connected in the secondary circuit of a potentiometer, the balancing length is found to be 540 cm. If the balancing length becomes 500 cm when the cell short circuited with 1 Ω, the internal resistance of the cell is

(A) 0.08 Ω (B) 0.04 Ω (C) 1.0 Ω (D) 1.08 Ω (E) 1.45 Ω

7. Two particles of equal charges after being accelerated through the same potential difference enter a uniform transverse magnetic field and describe circular paths of radii R_1 and R_2 respectively. Then the ratio of their masses (M_1/M_2) is

(A) $\frac{R_1}{R_2}$ (B) $\left(\frac{R_1}{R_2}\right)^2$ (C) $\frac{R_2}{R_1}$ (D) $\left(\frac{R_2}{R_1}\right)^2$ (E) $\left(\frac{R_1}{R_2}\right)^{1/2}$

8. Electromagnets are made of soft iron because soft iron has

(A) low susceptibility and low retentivity
(B) low susceptibility and high retentivity
(C) high permeability and low retentivity
(D) high permeability and high coercivity
(E) low permeability and low retentivity

(Space for Rough Work)

9. Which one of the following characteristics is not associated with a ferromagnetic material?

(A) It is strongly attracted by a magnet
(B) It tends to move from a region of strong magnetic field to a region of weak magnetic field
(C) Its origin is the spin of electrons
(D) Above the Curie temperature, it exhibits paramagnetic properties
(E) Its magnetic susceptibility is large and positive

10. The oscillating frequency of a cyclotron is 10 MHz. If the radius of its Dees is 0.5 m, the kinetic energy of a proton, which is accelerated by the cyclotron is

(A) 10.2 MeV (B) 2.55 MeV (C) 20.4 MeV
(D) 5.1 MeV (E) 1.5 MeV

11. In a certain place, the horizontal component of magnetic field is $\frac{1}{\sqrt{3}}$ times the vertical component. The angle of dip at this place is

(A) zero (B) $\pi/3$ (C) $\pi/2$
(D) $\pi/6$ (E) $\pi/4$

12. An alternating voltage $e = 200 \sin 100\, t$ is applied to a series combination of R = 30 Ω and an inductor of 400 mH. The power factor of the circuit is

(A) 0.01 (B) 0.2 (C) 0.05 (D) 0.042 (E) 0.6

13. The flux linked with a circuit is given by $\phi = t^3 + 3t - 7$. The graph between time (x-axis) and induced emf (y-axis) will be a

(A) straight line through the origin
(B) straight line with positive intercept
(C) straight line with negative intercept
(D) parabola through the origin
(E) parabola not through the origin

(Space for Rough Work)

14. If the self inductance of 500 turn coil is 125 mH, then the self inductance of similar coil of 800 turns is

(A) 48.8 mH (B) 200 mH (C) 187.5 mH
(D) 320 mH (E) 78.1 mH

15. A resistor 30 Ω, inductor of reactance 10 Ω and capacitor of reactance 10 Ω are connected in series to an a.c. voltage source $e = 300\sqrt{2}\sin(\omega t)$. The current in the circuit is

(A) $10\sqrt{2}$ A (B) 10 A (C) $30\sqrt{11}$ A
(D) $30/\sqrt{11}$ A (E) 5 A

16. A plane electromagnetic wave travelling along the X-direction has a wavelength of 3 mm. The variation in the electric field occurs in the Y-direction with an amplitude 66 V m^{-1}. The equations for the electric and magnetic fields as a function of x and t are respectively

(A) $E_y = 33\cos\pi \times 10^{11}\left(t-\frac{x}{c}\right)$, $B_z = 1.1\times10^{-7}\cos\pi\times10^{11}\left(t-\frac{x}{c}\right)$

(B) $E_y = 11\cos 2\pi\times10^{11}\left(t-\frac{x}{c}\right)$, $B_y = 11\times10^{-7}\cos 2\pi\times10^{11}\left(t-\frac{x}{c}\right)$

(C) $E_x = 33\cos\pi\times10^{11}\left(t-\frac{x}{c}\right)$, $B_x = 11\times10^{-7}\cos\pi\times10^{11}\left(t-\frac{x}{c}\right)$

(D) $E_y = 66\cos 2\pi\times10^{11}\left(t-\frac{x}{c}\right)$, $B_z = 2.2\times10^{-7}\cos 2\pi\times10^{11}\left(t-\frac{x}{c}\right)$

(E) $E_y = 66\cos\pi\times10^{11}\left(t-\frac{x}{c}\right)$, $B_y = 2.2\times10^{-7}\cos\pi\times10^{11}\left(t-\frac{x}{c}\right)$

17. A plane electromagnetic wave travels in free space along x-axis. At a particular point in space, the electric field along y-axis is 9.3 Vm^{-1}. The magnetic induction (B) along z-axis is

(A) 3.1×10^{-8} T (B) 3×10^{-5} T (C) 3×10^{-6} T
(D) 9.3×10^{-6} T (E) 3.1×10^{-7} T

(Space for Rough Work)

18. If the ratio of amounts of scattering of two light waves is 1 : 4, the ratio of their wavelengths is

(A) 1 : 2 (B) $\sqrt{2}:1$ (C) $1:\sqrt{2}$ (D) 1 : 1 (E) 2 : 1

19. In Young's experiment, the third bright band for light of wavelength 6000 Å coincides with the fourth bright band for another source of light in the same arrangement. Then the wavelength of second source is

(A) 3600 Å (B) 4000 Å (C) 5000 Å
(D) 4500 Å (E) 5500 Å

20. If the angle of minimum deviation is 60° for an equilateral prism, then the refractive index of the material of the prism is

(A) 1.41 (B) 1.5 (C) 1.6 (D) 1.33 (E) 1.73

21. The wavelength of red light from He-Ne laser is 633 nm in air but 474 nm in the aqueous humor inside the eye ball. Then the speed of red light through the aqueous humor is

(A) 3×10^8 m/s (B) 1.34×10^8 m/s (C) 2.25×10^8 m/s
(D) 2.5×10^8 m/s (E) 2.75×10^8 m/s

22. The radius of curvature of the convex face of a plano-convex lens is 15 cm and the refractive index of the material is 1.4. Then the power of the lens in dioptre is

(A) 1.6 (B) 1.66 (C) 2.6 (D) 2.66 (E) 1.4

23. The threshold wavelength for photoelectric emission from a material is 4800 Å. Photoelectrons will be emitted from the material, when it is illuminated with light from a

(A) 40 W blue lamp (B) 40 W green lamp (C) 100 W red lamp
(D) 100 W yellow lamp (E) 1000 W green lamp

(Space for Rough Work)

24. The energy released in the fission of 1 kg of $_{92}U^{235}$ is
(energy per fission = 200 MeV)

(A) 5.1×10^{26} eV (B) 5.1×10^{26} J (C) 8.2×10^{13} J
(D) 8.2×10^{13} MeV (E) 5.1×10^{23} MeV

25. The nuclear radius of a certain nucleus is 7.2 fm and it has a charge of 1.28×10^{-17} C. The number of neutrons inside the nucleus is

(A) 136 (B) 142 (C) 140 (D) 132 (E) 126

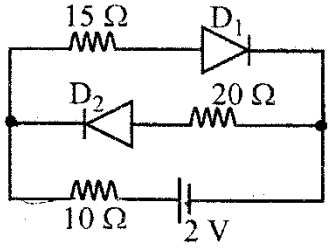
26. Which one of the following statements is true, if half-life of a radioactive substance is 1 month?

(A) $\frac{7}{8}$th part of the substance will disintegrate in 3 months
(B) $\frac{1}{8}$th part of the substance will remain undecayed at the end of 4 months
(C) The substance will disintegrate completely in 4 months
(D) $\frac{1}{16}$th part of the substance will remain undecayed at the end of 3 months
(E) The substance will disintegrate completely in 2 months

27. A common emitter amplifier gives an output of 3 V for an input of 0.01 V. If β of the transistor is 100 and the input resistance is 1 kΩ, then the collector resistance is

(A) 1 kΩ (B) 3 kΩ (C) 30 kΩ (D) 30 Ω (E) 6 kΩ

28. The current I through 10 ohm resistor in the circuit given below is



(A) 50 mA (B) 20 mA (C) 40 mA (D) 80 mA (E) 35 mA

(Space for Rough Work)

29. The combination of the following gates produces

(A) AND gate (B) NAND gate (C) NOR gate
(D) OR gate (E) NOT gate

30. The resonance frequency of the tank circuit of an oscillator when

$L = \frac{10}{\pi^2}$ mH and C = 0.04 μF are connected in parallel is

(A) 250 kHz (B) 25 kHz (C) 2.5 kHz
(D) 25 MHz (E) 2.5 MHz

31. In satellite communication

1. the frequency used lies between 5 MHz and 10 MHz
2. the uplink and downlink frequencies are different
3. the orbit of geostationary satellite lies in the equatorial plane at an inclination of 0°

In the above statements

(A) only 2 and 3 true (B) all are true (C) only 2 true
(D) only 1 and 2 true (E) only 1 and 3 true

32. The principle used in the transmission of signals through an optical fiber is

(A) total internal reflection (B) reflection (C) refraction
(D) dispersion (E) interference

33. Which of the following statements is wrong?

(A) Ground wave propagation can be sustained at frequencies 500 kHz to 1500 kHz
(B) Satellite communication is useful for the frequencies above 30 MHz
(C) Sky wave propagation is useful in the range of 30 to 40 MHz
(D) Space wave propagation takes place through tropospheric space
(E) The phenomenon involved in skyware propagation is total internal reflection

34. A signal wave of frequency 12 kHz is modulated with a carrier wave of frequency 2.51 MHz. The upper and lower side band frequencies are respectively

(A) 2512 kHz and 2508 kHz (B) 2522 kHz and 2488 kHz
(C) 2502 kHz and 2498 kHz (D) 2522 kHz and 2498 kHz
(E) 2512 kHz and 2488 kHz

(Space for Rough Work)

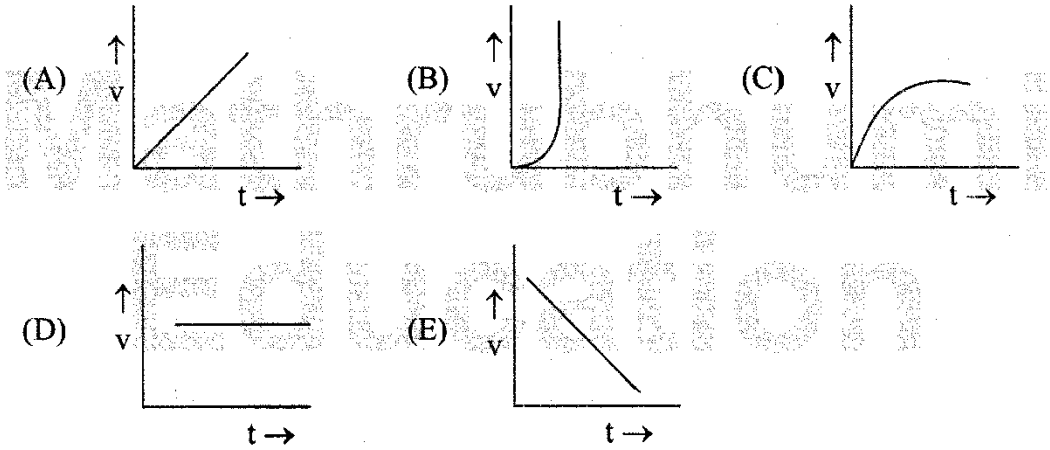
35. Millikan's oil-drop experiment established that

(A) electric charge depends on velocity
(B) specific charge of electron is 1.76×10^{11} C kg^{-1}
(C) electron has wave nature
(D) electric charge is quantized
(E) electron has particle nature

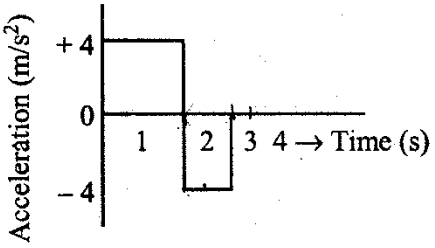
36. If C is the capacitance and V is the potential, the dimensional formula for CV^2 is

(A) ML^2T^{-1} (B) $ML^{-2}T^{-3}$ (C) ML^2T^{-2}
(D) $ML^{-2}T^{-2}$ (E) $ML^{-1}T^{-2}$

37. An object is dropped from rest. Its v-t graph is



38. A particle starts from rest at $t = 0$ and moves in a straight line with an acceleration as shown below. The velocity of the particle at $t = 3$ s is



(A) 2 ms^{-1} (B) 4 ms^{-1} (C) 6 ms^{-1}
(D) 8 ms^{-1} (E) 1 ms^{-1}

(Space for Rough Work)

39. Two cars A and B are moving with same speed of 45 km/hr along same direction. If a third car C coming from the opposite direction with a speed of 36 km/hr meets two cars in an interval of 5 minutes, the distance of separation of two cars A and B should be (in km)

(A) 6.75 (B) 7.25 (C) 5.55 (D) 8.35 (E) 4.75

40. Two particles A and B are projected with same speed so that the ratio of their maximum heights reached is 3 : 1. If the speed of A is doubled without altering other parameters, the ratio of the horizontal ranges attained by A and B is

(A) 1 : 1 (B) 2 : 1 (C) 4 : 1 (D) 3 : 2 (E) 4 : 3

41. An object of mass 5 kg is attached to the hook of a spring balance and the balance is suspended vertically from the roof of a lift. The reading on the spring balance when the lift is going up with an acceleration of 0.25 ms^{-2} is ($g = 10\ ms^{-2}$)

(A) 51.25 N (B) 48.75 N (C) 52.75 N (D) 47.25 N (E) 55 N

42. A particle acted upon by constant forces $4\mathbf{i}+\mathbf{j}-3\mathbf{k}$ and $3\mathbf{i}+\mathbf{j}-\mathbf{k}$ is displaced from the point $\mathbf{i}+2\mathbf{j}+3\mathbf{k}$ to the point $5\mathbf{i}+4\mathbf{j}+\mathbf{k}$. The total work done by the forces in SI unit is

(A) 20 (B) 40 (C) 50 (D) 30 (E) 35

(Space for Rough Work)

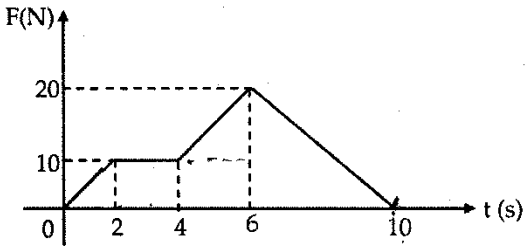
43. Two bodies A and B have masses 20 kg and 5 kg respectively. Each one is acted upon by a force of 4 kg wt. If they acquire the same kinetic energy in times t_A and t_B, then the ratio $\frac{t_A}{t_B}$ is

(A) $\frac{1}{2}$ (B) 2 (C) $\frac{2}{5}$ (D) $\frac{5}{6}$ (E) $\frac{1}{5}$

44. A bullet of mass 0.05 kg moving with a speed of 80 ms^{-1} enters a wooden block and is stopped after a distance of 0.40 m. The average resistive force exerted by the block on the bullet is

(A) 300 N (B) 20 N (C) 400 N
(D) 40 N (E) 200 N

45. A particle of mass 2 kg is initially at rest. A force acts on it whose magnitude changes with time. The force time graph is shown below



The velocity of the particle after 10 s is

(A) 20 ms^{-1} (B) 10 ms^{-1} (C) 75 ms^{-1} (D) 26 ms^{-1} (E) 50 ms^{-1}

(Space for Rough Work)

46. The height of the dam, in an hydroelectric power station is 10 m. In order to generate 1 MW of electric power, the mass of water (in kg) that must fall per second on the blades of the turbine is

(A) 10^6 (B) 10^5 (C) 10^3 (D) 10^4 (E) 10^2

47. A spring gun of spring constant 90 N/cm is compressed 12 cm by a ball of mass 16 g. If the trigger is pulled, the velocity of the ball is

(A) 50 ms^{-1}
(B) 9 ms^{-1}
(C) 40 ms^{-1}
(D) 60 ms^{-1}
(E) 90 ms^{-1}

48. A particle is moving under the influence of a force given by $F = kx$ where k is a constant and x is the distance moved. The energy (in joules) gained by the particle in moving from $x = 0$ to $x = 3$ is

(A) $2.5k$ (B) $3.5k$ (C) $4.5k$ (D) $9k$ (E) $9.5k$

(Space for Rough Work)

49. A thin circular ring of mass M and radius R rotates about an axis through its centre and perpendicular to its plane, with a constant angular velocity ω. Four small spheres each of mass m (negligible radius) are kept gently to the opposite ends of two mutually perpendicular diameters of the ring. The new angular velocity of the ring will be :

(A) 4ω (B) $\frac{M}{4m}\omega$ (C) $\left(\frac{M+4m}{M}\right)\omega$

(D) $\left(\frac{M}{M-4m}\right)\omega$ (E) $\left(\frac{M}{M+4m}\right)\omega$

50. The angular velocity of a wheel increases from 100 rps to 300 rps in 10 seconds. The number of revolutions made during that time is

(A) 600 **(B) 1500** (C) 1000 (D) 3000 (E) 2000

51. Three identical spheres, each of mass 3 kg are placed touching each other with their centres lying on a straight line. The centres of the spheres are marked as P, Q and R respectively. The distance of centre of mass of the system from P is

(A) $\frac{PQ+QR+PR}{3}$ (B) $\frac{PQ+PR}{3}$ (C) $\frac{PQ+QR+PR}{9}$

(D) $\frac{PQ+PR}{9}$ (E) $\frac{PQ+QR}{3}$

52. Infinite number of masses, each 1 kg, are placed along the x-axis at $x = \pm 1$ m, ± 2 m, ± 4 m, ± 8 m, ± 16 m ... . The magnitude of the resultant gravitational potential in terms of gravitational constant G at the origin ($x = 0$) is

(A) G/2 (B) G (C) 2G (D) 4G (E) 8G

(Space for Rough Work)

53. Three identical bodies of mass M are located at the vertices of an equilateral triangle of side L. They revolve under the effect of mutual gravitational force in a circular orbit, circumscribing the triangle while preserving the equilateral triangle. Their orbital velocity is

(A) $\sqrt{\frac{GM}{L}}$ (B) $\sqrt{\frac{3GM}{2L}}$ (C) $\sqrt{\frac{3GM}{L}}$

(D) $\sqrt{\frac{2GM}{3L}}$ (E) $\sqrt{\frac{GM}{3L}}$

54. A satellite is revolving around the earth with a kinetic energy E. The minimum addition of kinetic energy needed to make it escape from its orbit is

(A) 2E (B) $\sqrt{E}$ (C) E/2 (D) $\sqrt{E/2}$ (E) E

55. Eight drops of a liquid of density ρ and each of radius '*a*' are falling through air with a constant velocity 3.75 cms^{-1}. When the eight drops coalesce to form a single drop the terminal velocity of the new drop will be

(A) $1.5 \times 10^{-2}\ ms^{-1}$ (B) $2.4 \times 10^{-2}\ ms^{-1}$ (C) $0.75 \times 10^{-2}\ ms^{-1}$

(D) $25 \times 10^{-2}\ ms^{-1}$ (E) $15 \times 10^{-2}\ ms^{-1}$

56. If the volume of a block of aluminum is decreased by 1%, the pressure (stress) on its surface is increased by (Bulk modulus of Al = $7.5 \times 10^{10}\ Nm^{-2}$)

(A) $7.5 \times 10^{10}\ Nm^{-2}$ (B) $7.5 \times 10^{8}\ Nm^{-2}$ (C) $7.5 \times 10^{6}\ Nm^{-2}$

(D) $7.5 \times 10^{4}\ Nm^{-2}$ (E) $7.5 \times 10^{2}\ Nm^{-2}$

57. The excess pressure inside one soap bubble is three times that inside a second soap bubble, then the ratio of their surface areas is

(A) 1 : 9 (B) 1 : 3 (C) 3 : 1 (D) 1 : 27 (E) 9 : 1

(Space for Rough Work)

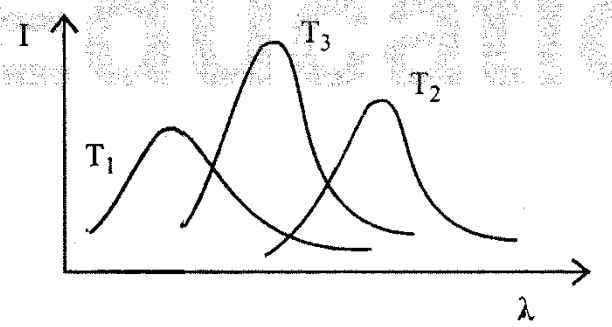
58. The area of cross-section of one limb of an U-tube is twice that of the other. Both the limbs contain mercury at the same level. Water is poured in the wider tube so that mercury level in it goes down by 1 cm. The height of water column is (density of water = 10^3 kg m^{-3}, density of mercury = 13.6×10^{-3} kg m^{-3})

(A) 13.6 cm (B) 40.8 cm (C) 27.2 cm (D) 54.4 cm (E) 6.8 cm

59. A bubble of 8 mole of helium is submerged at a certain depth in water. The temperature of water increases by 30°C. How much heat is added approximately to helium during expansion?

(A) 4000 J (B) 3000 J (C) 3500 J (D) 4500 J (E) 5000 J

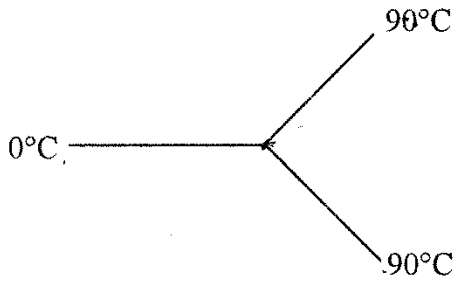
60. The plots of intensity of radiation versus wavelength of three black bodies at temperatures T_1, T_2 and T_3 are shown. Then,



(A) $T_3 > T_2 > T_1$ (B) $T_1 > T_2 > T_3$ (C) $T_2 > T_3 > T_1$
(D) $T_1 > T_3 > T_2$ (E) $T_3 > T_1 > T_2$

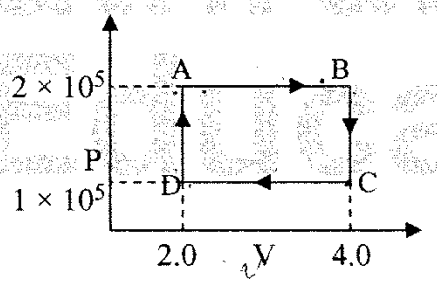
(Space for Rough Work)

61. Three rods made of same material and having same cross section have been joined as shown in the figure. Each rod is same length. The temperature at the junction of the three rods is



(A) 45°C (B) 90°C (C) 30°C (D) 20°C (E) 60°C

62. The P-V diagram of a gas undergoing a cyclic process (A B C D A) is shown in the graph where P is in units of Nm^{-2} and V in cm^{-3}. Identify the incorrect statement



(A) 0.4 J of work is done by the gas from A to B
(B) 0.2 J of work is done on the gas from C to D
(C) No work is done by the gas from B to C
(D) Net work done by the gas in one cycle is 0.2 J
(E) Work is done by the gas in going from B to C and on the gas from D to A

63. The period of a simple pendulum inside a stationary lift is T. The lift accelerates upwards with an acceleration of $g/3$. The time period of pendulum will be

(A) $\sqrt{2}T$ (B) $\frac{T}{\sqrt{2}}$ (C) $\frac{\sqrt{3}}{2}T$ (D) $\frac{T}{3}$ (E) $\frac{2}{3}T$

(Space for Rough Work)

64. The amplitude of S.H.M. $y = 2\ (\sin 5\pi t + \sqrt{2}\cos 5\pi t)$ is

(A) 2 (B) $2\sqrt{2}$ (C) 4 (D) $2\sqrt{3}$ (E) $4\sqrt{2}$

65. The total energy of a simple harmonic oscillator is proportional to

(A) square root of displacement
(B) velocity
(C) frequency
(D) amplitude
(E) square of the amplitude

66. A tuning fork of frequency 250 Hz produces a beat frequency of 10 Hz when sounded with a sonometer vibrating at its fundamental frequency. When the tuning fork is filed, the beat frequency decreases. If the length of the sonometer wire is 0.5 m, the speed of the transverse wave is

(A) 260 ms^{-1} (B) 250 ms^{-1} (C) 240 ms^{-1}
(D) 500 ms^{-1} (E) 520 ms^{-1}

67. A glass tube of length 1.0 m is completely filled with water. A vibrating tuning fork of frequency 500 Hz is kept over the mouth of the tube and the water is drained out slowly at the bottom of the tube. If velocity of sound in air is 330 ms^{-1}, then the total number of resonances that occur will be

(A) 2 (B) 3 (C) 1 (D) 5 (E) 4

68. A bus is moving with a velocity of 5 ms^{-1} towards a huge wall. The driver sounds a horn of frequency 165 Hz. If the speed of sound in air is 335 ms^{-1}, the number of beats heard per second by a passenger inside the bus will be

(A) 3 (B) 4 (C) 5 (D) 6 (E) 7

(Space for Rough Work)

69. Two identical conducting spheres carrying different charges attract each other with a force F when placed in air medium at a distance '*d*' apart. The spheres are brought into contact and then taken to their original positions. Now the two spheres repel each other with a force whose magnitude is equal to that of the initial attractive force. The ratio between initial charges on the spheres is

(A) $-\left(3+\sqrt{8}\right)$ only

(B) $-3+\sqrt{8}$ only

(C) $-\left(3+\sqrt{8}\right)$ or $\left(-3+\sqrt{8}\right)$

(D) $+\sqrt{3}$

(E) $-\sqrt{8}$

70. Small drops of the same size are charged to V volt each. If n such drops coalesce to form a single large drop, its potential will be

(A) Vn (B) V/n (C) $Vn^{1/3}$ (D) $Vn^{2/3}$ (E) $Vn^{1/2}$

71. A capacitor of capacitance value 1 μF is charged to 30 V and the battery is then disconnected. If it is connected across a 2 μF capacitor, the energy lost by the system is

(A) 300 μJ (B) 450 μJ (C) 225 μJ
(D) 150 μJ (E) 100 μJ

72. An electric dipole of length 1 cm is placed with the axis making an angle of 30° to an electric field of strength $10^4\,NC^{-1}$. If it experiences a torque of $10\sqrt{2}$ Nm, the potential energy of the dipole is

(A) 0.245 J (B) 2.45 J (C) 0.0245 J (D) 245.0 J (E) 24.5 J

(Space for Rough Work)

73. For the two gaseous reactions, following data are given

$A \rightarrow B$; $k_1 = 10^{10} e^{-20000/T}$

$C \rightarrow D$; $k_2 = 10^{12} e^{-24606/T}$

the temperature at which k_1 becomes equal to k_2 is

(A) 400 K (B) 1000 K (C) 800 K (D) 1500 K (E) 500 K

74. Plot of log x/m against log P is a straight line inclined at an angle of 45°. When the pressure is 0.5 atm and Freundlich parameter, k is 10, the amount of solute adsorbed per gram of adsorbent will be (log 5 = 0.6990)

(A) 1 g (B) 2 g (C) 3 g (D) 5 g (E) 2.5 g

75. The number of moles of lead nitrate needed to coagulate 2 mol of colloidal $[AgI]I^-$ is

(A) 2 (B) 1 (C) 1/2 (D) 2/3 (E) 5/2

76. The primary and secondary valencies of chromium in the complex ion, dichlorodioxalatochromium(III), are respectively

(A) 3, 4 (B) 4, 3 (C) 3, 6 (D) 6, 3 (E) 4, 4

77. The two isomers X and Y with the formula $Cr(H_2O)_5ClBr_2$ were taken for experiment on depression in freezing point. It was found that one mole of X gave depression corresponding to 2 moles of particles and one mole of Y gave depression due to 3 moles of particles. The structural formulae of X and Y respectively are

(A) $[Cr(H_2O)_5Cl]Br_2$; $[Cr(H_2O)_4Br_2]Cl.H_2O$
(B) $[Cr(H_2O)_5Cl]Br_2$; $[Cr(H_2O)_3ClBr_2].2H_2O$
(C) $[Cr(H_2O)_5Br]BrCl$; $[Cr(H_2O)_4ClBr]Br.H_2O$
(D) $[Cr(H_2O)_5Cl]Br_2$; $[Cr(H_2O)_4ClBr]Br.H_2O$
(E) $[Cr(H_2O)_4Br_2]Cl.H_2O$; $[Cr(H_2O)_5Cl]Br_2$

78. Which of the following process is suitable for the purification of aniline?

(A) simple distillation (B) fractional distillation (C) fractional crystallization
(D) steam distillation (E) azeotropic distillation

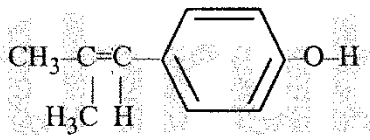
(Space for Rough Work)

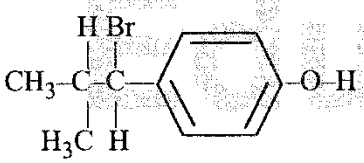
79. 0.1 mole of a carbohydrate with empirical formula CH_2O contains 1 g of hydrogen. What is its molecular formula?

(A) $C_5H_{10}O_5$ (B) $C_6H_{12}O_6$ (C) $C_4H_8O_4$ (D) $C_3H_6O_3$ (E) $C_2H_4O_2$

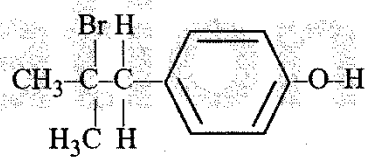
80. Of the isomeric hexanes, the isomers that give the minimum and maximum number of monochloro derivatives are respectively

(A) 3-methylpentane and 2,3-dimethylbutane
(B) 2,3-dimethylbutane and n-hexane
(C) 2,2-dimethylbutane and 2-methylpentane
(D) 2,3-dimethylbutane and 2-methylpentane
(E) 2-methylpentane and 2,2-dimethylbutane

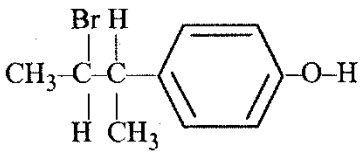
81. The reaction of  with HBr gives predominantly



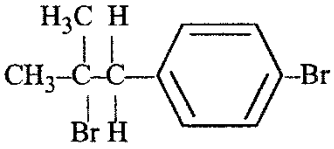
(A)



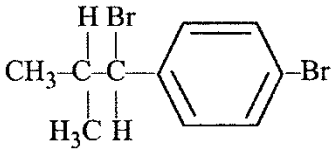
(B)



(C)



(D)



(E)

(Space for Rough Work)

82. Which one of the following carbanions is the least stable?

(A) $CH_3CH_2^-$ (B) $HC\equiv C^-$ (C) $(C_6H_5)_3C^-$

(D) CH_3^- (E) $(CH_3)_3C^-$

83. An organic compound with molecular formula C_6H_{12} upon ozonolysis gave only acetone as the product. The compound is

(A) 2,3-dimethyl-1-butene (B) 3-hexene (C) 2-hexene
(D) 2,3-dimethyl-2-butene (E) 3-methyl-1-pentene

84. Which one of the following compounds is capable of existing in a meso form?

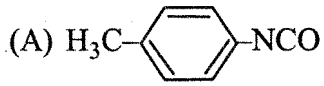
(A) 3,3-dibromopentane
(B) 4-bromo-2-pentanol
(C) 3-bromo-2-pentanol
(D) 2,3-dibromopentane
(E) 2,4-dibromopentane

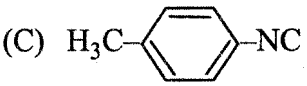
85. Acyclic stereoisomers having the molecular formula C_4H_7Cl are classified and tabulated. Find out the correct set of numbers

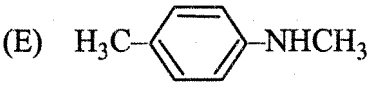
	Geometrical	Optical
(A)	6	2
(B)	4	2
(C)	6	0
(D)	4	0
(E)	5	2

(Space for Rough Work)

86. The reaction of $CHCl_3$ and alcoholic KOH with p-toluidine gives

(A)  (B) 

(C)  (D) 

(E) 

87. A dihalogen derivative 'X' of a hydrocarbon with three carbon atoms reacts with alcoholic KOH and produces another hydrocarbon which forms a red precipitate with ammonical Cu_2Cl_2. 'X' gives an aldehyde on reaction with aqueous KOH. The compound 'X' is

(A) 1,3-Dichloropropane
(B) 1,2-Dichloropropane
(C) 2,2-Dichloropropane
(D) 1,1-Dichloropropane
(E) 1,3-Dichloropropene

88. An organic compound (X) with molecular formula C_7H_8O is insoluble in aqueous $NaHCO_3$ but dissolves in NaOH. When treated with bromine water (X) rapidly gives (Y), $C_7H_5OBr_3$. The compounds (X) and (Y) respectively are

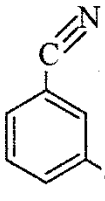
(A) benzyl alcohol and 2, 4, 6-tribromo-3-methoxy benzene
(B) benzyl alcohol and 2, 4, 6-tribromo-3-methyl phenol
(C) o-cresol and 3, 4, 5-tribromo-2-methyl phenol
(D) methoxybenzene and 2, 4, 6-tribromo-3-methoxy benzene
(E) m-cresol and 2, 4, 6-tribromo-3-methyl phenol

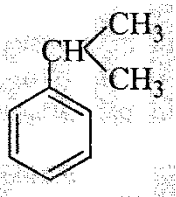
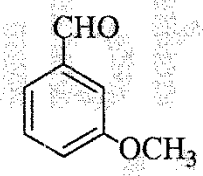
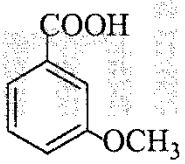
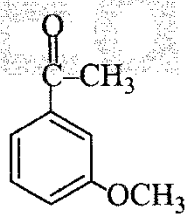
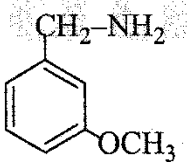
(Space for Rough Work)

89. The products obtained when benzyl phenyl ether is heated with HI in the mole ratio 1:1 are

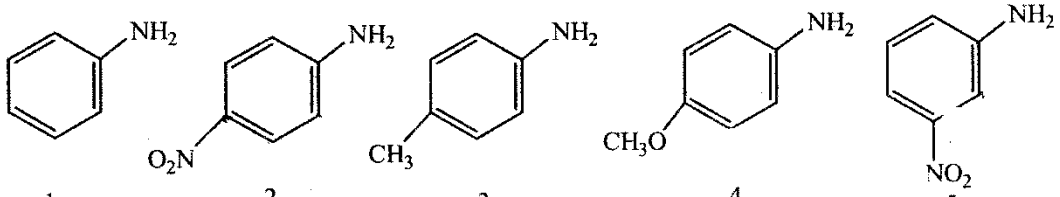
1. phenol
2. benzyl alcohol
3. benzyl iodide
4. iodobenzene

(A) 1 and 3 only (B) 3 and 4 only (C) 1 and 4 only
(D) 2 and 4 only (E) 2 and 3 only

90. The product P in the reaction  + $CH_3MgBr \longrightarrow Q \xrightarrow{H_3O^+} P$ is

(A) 
(B) 
(C) 
(D) 
(E) 

91. The correct order of increasing basic nature of the following bases is



1 2 3 4 5

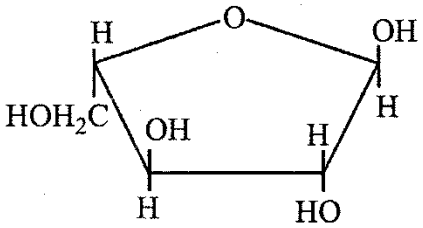
(A) 2<5<1<3<4 (B) 5<2<1<3<4 (C) 2<5<1<4<3
(D) 5<2<1<4<3 (E) 2<5<4<3<1

(Space for Rough Work)

92. Which one of the following is a non-steroidal hormone?

(A) estradiol (B) prostaglandin (C) progesterone
(D) estrone (E) testosterone

93. Which set of terms correctly identifies the carbohydrate shown?



1. Pentose 2. Hexose 3. Aldose
4. Ketose 5. Pyranose 6. Furanose

(A) 1, 3 and 6 (B) 1, 3 and 5 (C) 2, 3 and 5
(D) 2, 3 and 6 (E) 1, 4 and 6

94. Which of the following is used as an oxidizer in rocket propellants?

(A) alcohol
(B) acrylic rubber
(C) hydrazine
(D) polyurethane
(E) ammonium perchlorate

95. Which among the following is not an antibiotic?

(A) Penicillin
(B) Oxytocin
(C) Erythromycin
(D) Tetracyclin
(E) Ofloxacin

(Space for Rough Work)

96. MnO_4^- ions are reduced in acidic condition to Mn^{2+} ions whereas they are reduced in neutral condition to MnO_2. The oxidation of 25 ml of a solution X containing Fe^{2+} ions required in acidic condition 20 ml of a solution Y containing MnO_4^- ions. What volume of solution Y would be required to oxidise 25 ml of solution X containing Fe^{2+} ions in neutral condition?

(A) 11.4 ml
(B) 12.0 ml
(C) 33.3 ml
(D) 35.0 ml
(E) 25.0 ml

97. The percentage of an element M is 53 in its oxide of molecular formula M_2O_3. Its atomic mass is about

(A) 45
(B) 9
(C) 18
(D) 36
(E) 27

98. The electronic configuration of the element with maximum electron affinity is

(A) $1s^2, 2s^2, 2p^3$
(B) $1s^2, 2s^2, 2p^5$
(C) $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
(D) $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
(E) $1s^2, 2s^2, 2p^6, 3s^1$

(Space for Rough Work)

99. The incorrect statement/s among the following is/are

I. NCl_5 does not exist while PCl_5 does

II. Lead prefers to form tetravalent compounds

III. The three C–O bonds are not equal in the carbonate ion

IV. Both O_2^+ and NO are paramagnetic

(A) I, III and IV (B) I and IV (C) II and III
(D) I and III (E) IV only

100. A solid compound contains X, Y and Z atoms in a cubic lattice with X atoms occupying the corners. Y atoms in the body centered positions and Z atoms at the centres of faces of the unit cell. What is the empirical formula of the compound?

(A) XY_2Z_3 (B) XYZ_3 (C) $X_2Y_2Z_3$ (D) X_8YZ_6 (E) XYZ

101. KCl crystallises in the same type of lattice as does NaCl. Given that r_{Na^+}/r_{Cl^-} =0.55 and r_{K^+}/r_{Cl^-}=0.74. Calculate the ratio of the side of the unit cell for KCl to that of NaCl

(A) 1.123 (B) 0.891 (C) 1.414 (D) 0.414 (E) 1.732

102. The first ionisation energy of oxygen is less than that of nitrogen. Which of the following is the correct reason for this observation?

(A) lesser effective nuclear charge of oxygen than nitrogen
(B) lesser atomic size of oxygen than nitrogen
(C) greater interelectron repulsion between two electrons in the same p orbital counter balances the increase in effective nuclear charge on moving from nitrogen to oxygen
(D) greater effective nuclear charge of oxygen than nitrogen
(E) higher electronegativity of oxygen than nitrogen

(Space for Rough Work)

103.

Column I		Column II
a) He	i)	high electron affinity
b) Cl	ii)	most electropositive element
c) Ca	iii)	strongest reducing agent
d) Li	iv)	highest ionization energy

The correct match of contents in Column I with those in Column II is

(A) a-iii, b-i, c-ii, d-iv
(B) a-iv, b-iii, c-ii, d-i
(C) a-ii, b-iv, c-i, d-iii
(D) a- i, b-ii, c-iii, d-iv
(E) a-iv, b-i, c-ii, d-iii

104. Which pair of the following chlorides do not impart colour to the flame?

(A) $BeCl_2$ and $SrCl_2$ (B) $BeCl_2$ and $MgCl_2$ (C) $CaCl_2$ and $BaCl_2$
(D) $BaCl_2$ and $SrCl_2$ (E) $MgCl_2$ and $CaCl_2$

105. Sodium peroxide which is a yellow solid, when exposed to air becomes white due to the formation of

(A) H_2O_2 (B) Na_2O (C) Na_2O and O_3
(D) NaOH and Na_2CO_3 (E) NaOH and H_2O_2

106. Which one of the following reactions involves disproportionation?

(A) $2\ H_2SO_4 + Cu \longrightarrow CuSO_4 + 2\ H_2O + SO_2$
(B) $As_2O_3 + 3\ H_2S \longrightarrow As_2S_3 + 3\ H_2O$
(C) $2\ KOH + Cl_2 \longrightarrow KCl + KOCl + H_2O$
(D) $Ca_3P_2 + 6\ H_2O \longrightarrow 3\ Ca(OH)_2 + 2\ PH_3$
(E) $4\ NH_3 + 3\ O_2 \longrightarrow 2\ N_2 + 6\ H_2O$

107. The element evolving two different gases on reaction with conc. sulphuric acid is

(A) P (B) C (C) Hg (D) S (E) Sn

(Space for Rough Work)

108. Which one of the following reactions will occur on heating $AgNO_3$ above its melting point?

(A) $2\ AgNO_3 \longrightarrow 2\ Ag + 2\ NO_2 + O_2$

(B) $2\ AgNO_3 \longrightarrow 2\ Ag + N_2 + 3\ O_2$

(C) $2\ AgNO_3 \longrightarrow 2\ AgNO_2 + O_2$

(D) $2\ AgNO_3 \longrightarrow 2\ Ag + 2\ NO + 2\ O_2$

(E) $2\ AgNO_3 \longrightarrow Ag_2O + N_2O_3 + O_2$

109. Pick out the correct statements from the following

1. Cobalt(III) is more stable in octahedral complexes
2. Zinc forms coloured ions or complexes
3. Most of the d-block elements and their compounds are ferromagnetic
4. Osmium shows (VIII) oxidation state
5. Cobalt(II) is more stable in octahedral complexes

(A) 1 and 2 (B) 1 and 3 (C) 2 and 4 (D) 1 and 4 (E) 2 and 5

110. Identify the nuclear reaction that differs from the rest

(A) positron emission

(B) K - capture

(C) β - decay

(D) α - decay

(E) γ - decay

111. Two radioactive elements X and Y have half-lives of 6 min and 15 min respectively. An experiment starts with 8 times as many atoms of X as Y. How long it takes for the number of atoms of X left equals the number of atoms of Y left

(A) 6 min (B) 12 min (C) 48 min (D) 30 min (E) 24 min

(Space for Rough Work)

112. Using the following thermochemical equations

i) $S(rh) + 3/2\ O_2(g) \longrightarrow SO_3(g) \quad \Delta H = -2x$ kJ mol^{-1}

ii) $SO_2(g) + 1/2\ O_2(g) \longrightarrow SO_3(g) \quad \Delta H = -y$ kJ mol^{-1}

Find out the heat of formation of SO_2 (g) in kJ mol^{-1}

(A) $(2x + y)$ (B) $(x + y)$ (C) $(2x/y)$ (D) $(y - 2x)$ (E) $(2x - y)$

113. The lattice enthalpy and hydration enthalpy of four compounds are given below

Compound	Lattice enthalpy (in kJ mol^{-1})	Hydration enthalpy (in kJ mol^{-1})
P	+ 780	– 920
Q	+ 1012	– 812
R	+ 828	– 878
S	+632	– 600

The pair of compounds which is soluble in water is

(A) P and Q (B) Q and R (C) R and S

(D) Q and S (E) P and R

114. 1.6 mol of $PCl_5(g)$ is placed in 4 dm^3 closed vessel. When the temperature is raised to 500 K, it decomposes and at equilibrium 1.2 mole of $PCl_5(g)$ remains. What is the K_C value for the decomposition of $PCl_5(g)$ to $PCl_3(g)$ and $Cl_2(g)$ at 500 K ?

(A) 0.013 (B) 0.050 (C) 0.033 (D) 0.067 (E) 0.045

115. For a concentrated solution of a weak electrolyte A_xB_y of concentration 'c', the degree of dissociation 'α' is given as

(A) $\alpha = \sqrt{K_{eq} / c(x+y)}$ (B) $\alpha = \sqrt{K_{eq} c / (xy)}$

(C) $\alpha = (K_{eq} / c^{x+y-1} x^x y^y)^{1/(x+y)}$ (D) $\alpha = (K_{eq} / cxy)$

(E) $\alpha = (K_{eq} / c^{xy})$

116. The relative lowering of vapour pressure of an aqueous solution containing non-volatile solute is 0.0125. The molality of the solution is

(A) 0.70 (B) 0.50 (C) 0.60 (D) 0.80 (E) 0.40

(Space for Rough Work)

117. Two liquids X and Y form an ideal solution. The mixture has a vapour pressure of 400 mm at 300 K when mixed in the molar ratio of 1:1 and a vapour pressure of 350 mm when mixed in the molar ratio of 1:2 at the same temperature. The vapour pressures of the two pure liquids X and Y respectively are

(A) 250 mm, 550 mm
(B) 350 mm, 450 mm
(C) 350 mm, 700 mm
(D) 500 mm, 500 mm
(E) 550 mm, 250 mm

118. In which of the following the oxidation number of oxygen has been arranged in increasing order?

(A) $OF_2 < KO_2 < BaO_2 < O_3$
(B) $BaO_2 < KO_2 < O_3 < OF_2$
(C) $BaO_2 < O_3 < OF_2 < KO_2$
(D) $KO_2 < OF_2 < O_3 < BaO_2$
(E) $OF_2 < O_3 < KO_2 < BaO_2$

119. The pH of a solution obtained by mixing 50 ml of 1 N HCl and 30 ml of 1 N NaOH is [log 2.5=0.3979]

(A) 3.979 (B) 0.6021 (C) 12.042 (D) 1.2042 (E) 0.3979

120. For a zero order reaction the plot of concentration of reactant Vs time is (intercept refers to concentration axis)

(A) linear with +ve slope and zero intercept
(B) linear with –ve slope and zero intercept
(C) linear with –ve slope and non-zero intercept
(D) linear with +ve slope and non-zero intercept
(E) a curve asymptotic to concentration axis

(Space for Rough Work)