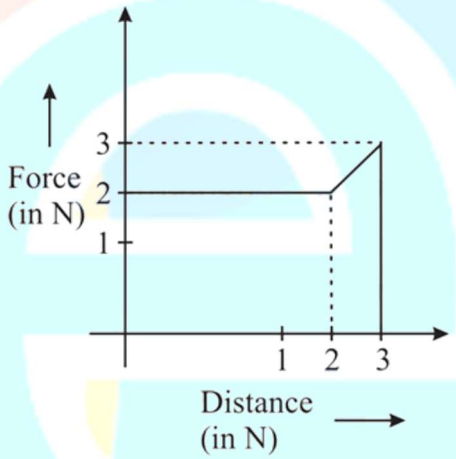
Q1. Ship A is sailing towards north-east with velocity) $\vec{v} = 30\hat{\imath} + 50\hat{\jmath}\text{kmh}^{-1}$ where $\hat{\imath}$ points east and $\hat{\jmath}$, north. The ship B is at a distance of 80 km east and 150 km north of Ship A and is sailing towards the west at 10 km h^{-1}. A will be at the minimum distance from B in:
(1) 4.2 h
(2) 3.2 h
(3) 2.6 h
(4) 2.2 h

Q2. In SI units, the dimensions of $\sqrt{\frac{\epsilon_0}{\mu_0}}$ is:
(1) $\text{AT}^2\text{M}^{-1}\ \text{L}^{-1}$
(2) $A^2T^3M^{-1}L^{-2}$
(3) $\text{A}^{-1}\text{TML}^3$
(4) $\text{AT}^{-3}\text{ML}^{3/2}$

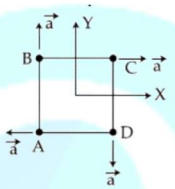
Q3. A particle moves in one dimension from rest under the influence of a force that varies with the distance traveled by the particle as shown in the figure. The kinetic energy of the particle after it has traveled 3 m is:



(1) 4 J
(2) 2.5 J
(3) 6.5 J
(4) 5 J

Q4. If 10^{22} gas molecules each of mass 10^{-26} kg collides with a surface (perpendicular to it) elastically per second over an area 1 m^2 with a speed 10^4 m/s, the pressure exerted by the gas molecules will be of the order of:
(1) 2 Pa
(2) 4 Pa
(3) 6 Pa
(4) 8 Pa

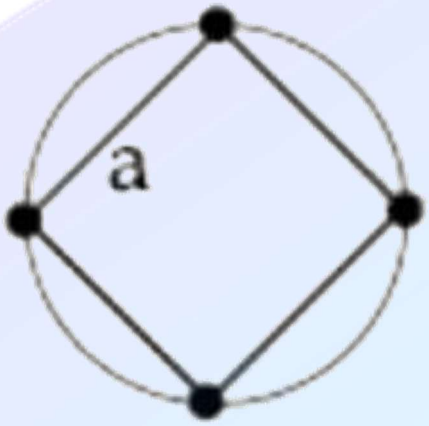
Q5. Four particles A, B, C and D with masses $m_A = m, m_B = 2m, m_C = 3$ m and $m_D = 4$ m are at the corners of a square. They have accelerations of equal magnitude with directions as shown. The acceleration of the centre of mass of the particles is:



(1) $\frac{a}{5}\hat{\imath} + \hat{\jmath}$
(2) $\frac{a}{5}\hat{\imath} - \hat{\jmath}$
(3) $a\hat{\imath} + \hat{\jmath}$
(4) Zero

Q6. A thin circular plate of mass M and radius R has its density varying as $\rho(r) = \rho_0 \text{r}$ with ρ_0 as constant and r is the distance from its centre. The moment of Inertia of the circular plate about an axis perpendicular to the plate and passing through its edge is $I = aMR^2$. The value of the coefficient a is:
(1) $\frac{3}{5}$
(2) $\frac{1}{2}$
(3) $\frac{8}{5}$
(4) $\frac{3}{2}$

Q7. Four identical particles of mass M are located at the corners of a square of side ' a '. What should be their speed if each of them revolves under the influence of other's gravitational field in a circular orbit circumscribing the square?



(1) $1.35\sqrt{\frac{GM}{a}}$

(2) $1.21\sqrt{\frac{GM}{a}}$

(3) $1.41\sqrt{\frac{GM}{a}}$

(4) $1.16\sqrt{\frac{GM}{a}}$

Q8. A boy's catapult is made of rubber cord which is 42 cm long, with 6 mm diameter of cross-section and of negligible mass. The boy keeps a stone weighing 0.02 kg on it and stretches the cord by 20 cm by applying a constant force. When released, the stone flies off with a velocity of 20 ms^{-1}. Neglect the change in the area of cross-section of the cord while stretched. The Young's modulus of rubber is closest to:

(1) 10^6 N m^{-2}

(2) 10^4 N m^{-2}

(3) 10^8 N m^{-2}

(4) 10^3 N m^{-2}

Q9. A steel wire having a radius of 2.0 mm , carrying a load of 4 kg , is hanging from a ceiling. Given that $g = 3.1$ m m s^{-2}, what will be the tensile stress that would be developed in the wire?

(1) 5.2×10^6 N m^{-2}

(2) 6.2×10^6 N m^{-2}

(3) 4.8×10^6 N m^{-2}

(4) 3.1×10^6 N m^{-2}

Q10. Water from a pipe is coming at a rate of 100 liters per minute. If the radius of the pipe is 5 cm , the Reynolds number for the flow is of the order of: (density of water $= 100$ kg/m^3, coefficient of viscosity of water $= 1$mPas)

(1) 10^2

(2) 10^4

(3) 10^3

(4) 10^6

Q11. A thermally insulated vessel contains 150 g of water at 0°C. Then the air from the vessel is pumped out adiabatically. A fraction of water turns into ice and the rest evaporates at 0°C itself. The mass of evaporated water will be closest to: (Latent heat of vaporization of water $= 2.10 \times 10^6$ J kg^{-1} and Latent heat of Fusion of water $= 3.36 \times 10^5$ J kg^{-1})

(1) 35 g

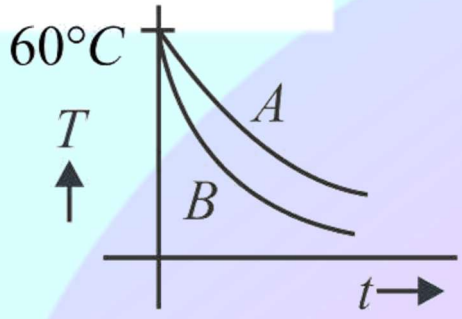
(2) 20 g

(3) 130 g

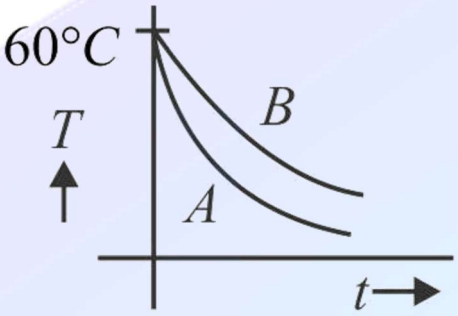
(4) 150 g

Q12. Two identical beakers A and B contain equal volumes of two different liquids at 60°C each and left to cool down. Liquid in A has density of 8×10^2 kg m^{-3} and specific heat of 2000 J kg^{-1} K^{-1} while the liquid in B has density 10^3 kg m^{-3} and specific heat of 4000 J kg^{-1} K^{-1}. Which of the following best describes their temperature versus time graph schematically? (assume the emissivity of both the beakers to be the same)

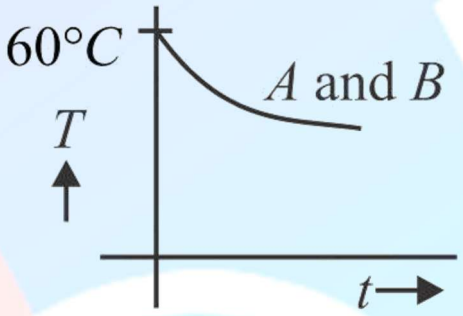
(1)



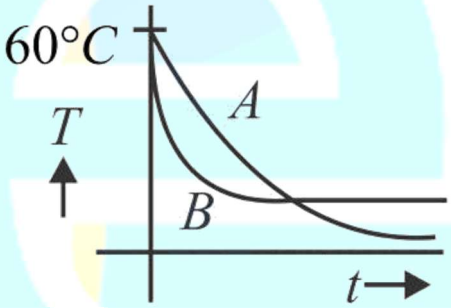
(2)



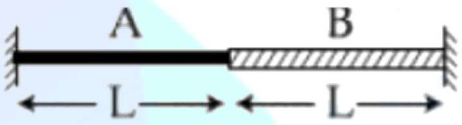
(3)



(4)



Q13. A wire of length 2L, is made by joining two wires A and B of same length but different radii r and $2r$ and made of the same material. It is vibrating at a frequency such that the joint of the two wires forms a node. If the number of antinodes in wire A is p and that in B is q then ratio $p:q$ is:



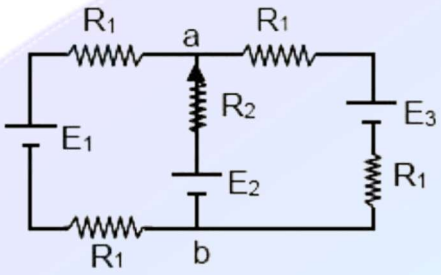
(1) 3: 5
(2) 4: 9
(3) 1: 4
(4) 1: 2

Q14. The bob of a simple pendulum has mass 2 g and a charge of $5.0\mu C$. It is at rest in a uniform horizontal electric field of intensity 2000 V/m At equilibrium, the angle that the pendulum makes with the vertical is: take $g = 10\ m/s^2$
(1) $\tan^{-1} 0.2$
(2) $\tan^{-1} 2.0$
(3) $\tan^{-1} 0.5$
(4) $\tan^{-1} 5.0$

Q15. A solid conducting sphere, having a charge Q, is surrounded by an uncharged conducting hollow spherical shell. Let the potential difference between the surface of the solid sphere and that of the outer surface of the hollow shell be V. If the shell is now given a charge of $-4Q$, the new potential difference between the same two surfaces is:
(1) $-2V$
(2) 2 V
(3) V
(4) 4 V

Q16. Voltage rating of a parallel plate capacitor is 500 V . Its dielectric can withstand a maximum electric field of 10^6 V/m. The plate area is 10^{-4} m^2. What is the dielectric constant if the capacitance is 15 pF ?
given $\epsilon_0 = 8.86 \times 10^{-12} C^2/Nm^2$
(1) 3.8
(2) 8.5
(3) 4.5
(4) 6.2

Q17. For the circuit shown, with $R_1 = 1.0\Omega, R_2 = 2.0\Omega, E_1 = 2$ V and $E_2 = E_3 = 4$ V, the potential difference between the points ' a ' and ' b ' is approximately (in V):



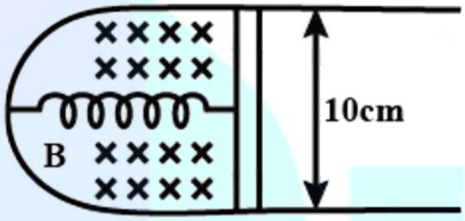
(1) 3.3
(2) 2.3
(3) 2.7
(4) 3.7

Q18. A 200Ω resistor has certain colour code. If one replaced the red colour by green in the code, the new resistance will be:
(1) 300Ω
(2) 100Ω
(3) 400Ω
(4) 500Ω

Q19. A circular coil having N turns and radius r carries a current I. It is held in the XZ plane in a magnetic field $B\hat{\imath}$. The torque on the coil due to the magnetic field is:
(1) $B\pi r^2 \mathrm{IN}$
(2) $\frac{\mathrm{Br}^2 I}{\pi N}$
(3) $\frac{B\pi\ ^2 I}{N}$
(4) Zero

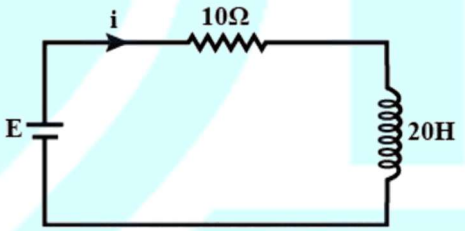
Q20. A thin strip 10 cm long is on a U shaped wire of negligible resistance and it is connected to a spring of spring constant 0.5 N m^{-1} (see figure). The assembly is kept in a uniform magnetic field of 0.1 T . If the strip is pulled from its equilibrium position and released, the number of oscillations it performs before its amplitude decreases by a factor of e is N . If the mass of the strip is 50 grams, its resistance 10Ω and air drag negligible,

N will be close to:



(1) 1000
(2) 5000
(3) 10000
(4) 50000

Q21. A 20 H inductor coil is connected to a 10Ω resistance in series as shown in figure. The time at which rate of dissipation of energy (Joule's heat) across resistance is equal to the rate at which magnetic energy is stored in the inductor, is:



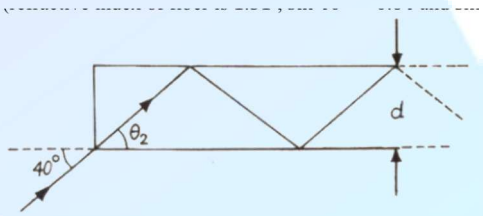
(1) $\frac{1}{2}\ln 2$
(2) $2\ln 2$
(3) $\frac{2}{\ln 2}$
(4) $\ln 2$

Q22. An alternating voltage $V(t) = 220\sin 100\pi t$ volt is applied to a purely resistive load of 50Ω. The time taken for the current to rise from half of the peak value to the peak value is:
(1) 7.21 ms
(2) 5.25 ms
(3) 2.24 ms
(4) 3.33 ms

Q23. A plane electromagnetic wave travels in free space along the x-direction. The electric field component of the wave at a particular point of space and time is $E = 6\mathrm{Vm}^{-1}$ along y-

direction. Its corresponding magnetic field component, B would be:
(1) 2×10^{-8} T along z direction
(2) 2×10^{-8} T along y direction
(3) 6×10^{-8} T along z − direction
(4) 6×10^{-8} T along x direction

Q24. In figure, the optical fiber is $l = 2$ m long and has a diameter of d $= 20\mu$ m. If a ray of light is incident on one end of the fiber at angle $\theta_1 = 40°$, the number of reflections it makes before emerging from the other end is close to: (refractive index of fiber is $1.31, \sin 40° = 0.64$ and $\sin^{-1} 0.49 = 30°$.)



(1) 55000
(2) 57000
(3) 45000
(4) 66000

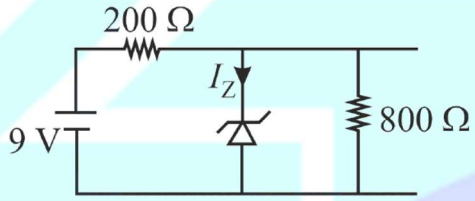
Q25. An upright object is placed at a distance of 40 cm in front of a convergent lens of focal length 20 cm . A convergent mirror of focal length 10 cm is placed at a distance of 60 cm on the other side of the lens. The position and size of the final image will be:
(1) 40 cm from the convergent lens, twice the size of the object
(2) 20 cm from the convergent mirror, twice the size of the object
(3) 40 cm from the convergent lens, same size of the object
(4) 20 cm from the convergent mirror, same size of the object

Q26. In an interference experiment the ratio of amplitudes of coherent waves is $\frac{a_1}{a_2} = \frac{1}{3}$. The ratio of maximum and minimum intensities of fringes will be:
(1) 4
(2) 9
(3) 2
(4) 18

Q27. Two particles move at right angle to each other. Their de Broglie wavelengths are λ_1 and λ_2 respectively. The particles suffer perfectly inelastic collision. The de Broglie wavelength λ of the final particle, is given by:
(1) $\frac{2}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$
(2) $\lambda = \frac{\lambda_1 + \lambda_2}{2}$
(3) $\lambda = \sqrt{\lambda_1 \lambda_2}$
(4) $\frac{1}{\lambda^2} = \frac{1}{\lambda_1^2} + \frac{1}{\lambda_2^2}$

Q28. Radiation coming from transitions $n = 2$ to $n = 1$ of hydrogen atoms fall on He^+ ions in $n = 1$ and $n = 2$ states. The possible transition of helium ions as they absorb energy from the radiation is:
(1) $n = 2 \rightarrow n = 3$
(2) $n = 2 \rightarrow n = 4$
(3) $n = 2 \rightarrow n = 5$
(4) $n = 1 \rightarrow n = 4$

Q29. The reverse break down voltage of a Zener diode is 5.6 V in the given circuit.



The current I_z through the Zener is:
(1) 10 mA
(2) 7 mA
(3) 17 mA
(4) 15 mA

Q30. The wavelength of the carrier waves in a modern optical fiber communication network is close to:
(1) 2400 nm
(2) 900 nm
(3) 600 nm
(4) 1500 nm

Q31. The quantum number of four electrons are given below:
I. $n = 4, l = 2, m_l = -2, m_s = -1/2$
II. $n = 3, l = 2, m_l = 1, m_s = +1/2$
III. $n = 4, l = 1, m_l = 0, m_s = +1/2$
IV. $n = 3, l = 1, m_l = 1, m_s = -1/2$

The correct order of their increasing energies will be:
(1) I < III < II < IV
(2) IV < II < III < I
(3) I < II < III < II
(4) IV < III < II < I

Q32. The size of the iso-electronic species Cl^-, Ar and Ca^{2+} is affected by:
(1) nuclear charge
(2) azimuthal quantum number of valence shell
(3) electron-electron interaction in the outer orbitals
(4) Principal quantum number of valence shell

Q33. Which one of the following equations does not correctly represent the first law of thermodynamics for the given processes involving an ideal gas? (Assume non- expansion work is zero)
(1) Isochoric process :
(2) Isochoric process :
(3) Cyclic process :
(4) Adiabatic process :
$\Delta U = q$
$q = -w$
$q = -w$
$\Delta U = -W$

Q34. For silver, $C_p(JK^{-1}\ mol^{-1}) = 23 + 0.01\ T$. If the temperature T of 3 moles of silver is raised from 300 K to 1000 K at 1 atm pressure, the value of ΔH will be close to:
(1) 16 kJ
(2) 62 kJ
(3) 13 kJ
(4) 21 kJ

Q35. If solubility product of $Zr_3(PO_4)_4$ is denoted by K_{sp} and its molar solubility is denoted by S , then which of the following relation between S and K_{sp} is correct?
(1) $S = \frac{K_{sp}^{\frac{1}{6}}}{144}$
(2) $S = \frac{K_{sp}}{6912}^{\frac{1}{7}}$
(3) $S = \frac{K_{sp}}{929}^{\frac{1}{9}}$
(4) $S = \frac{K_{sp}^{\frac{1}{7}}}{216}$

Q36. In order to oxidize a mixture of one mole of each of FeC_2O_4, $Fe_2(C_2O_4)_3$, $FeSO_4$ and $Fe_2(SO_4)_3$ in acidic medium, the number of moles of $KMnO_4$ is:
(1) 1
(2) 2
(3) 3
(4) 1.5

Q37. Given that,
$E^O_{O_2/H_2O} = +1.23$ V;
$E^0_{S_2O_8^{2-}/SO_4^{2-}} = 2.05$ V
$E^0_{Br_2/Br^-} = +1.09$ V;
$E^0_{Au^{3+}/Au} = 1.4$ V

The strongest oxidizing agent is
(1) O_2
(2) $S_2O_8^{2-}$
(3) Br_2
(4) Au^{3+}

Q38. 100 mL of a water sample contains 0.81 g of calcium bicarbonate and 0.73 g of magnesium bicarbonate. The hardness of this water sample expressed in terms of equivalents of $CaCO_3$ is: (molar mass of calcium bicarbonate is $162 g mmol^{-1}$ and magnesium bicarbonate is $146\ g\ mol^{-1}$)
(1) 100 ppm
(2) 1,000ppm
(3) 5,000ppm
(4) 10,000ppm

Q39. The correct order of hydration enthalpies of alkali metal ions is:
(1) $Na^+ > Li^+ > K^+ > Rb_{(2)}$ Nets$^+ > Li^+ > K^+ > Cs(3 > LRb^+ > Na^+ > K^+ > Rb^+4$)
$LCSs^+ > Na^+ > K^+ > Cs^+ > Rb^+$

Q40. Diborane B_2H_6 reacts independently with O_2 and H_2O to produce, respectively:

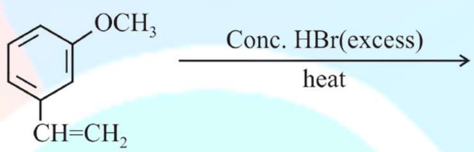
(1) HBO_2 and H_3BO_3
(2) H_3BO_3 and B_2O_3
(3) B_2O_3 and $[BH_4]^-$
(4) B_2O_3 and H_3BO_3

Q41. The IUPAC name of the following compound is:

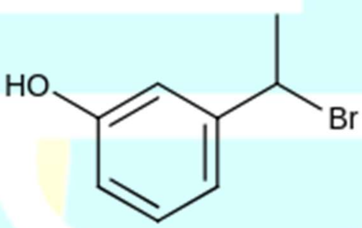
$$CH_3OH$$
$$H_3C - CH - CH -$$
$$CH_2 - COOH$$

(1) 4 - Methyl - 3 - hydro[illegible]dimethylpentanoi

Q42. The major product of the f following reaction is:



(1)



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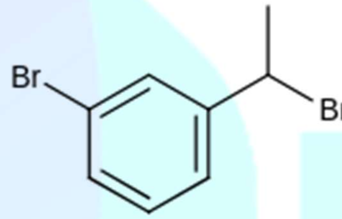

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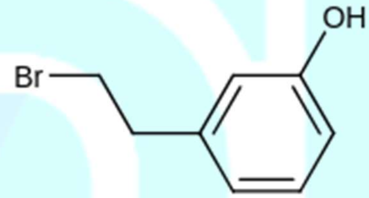
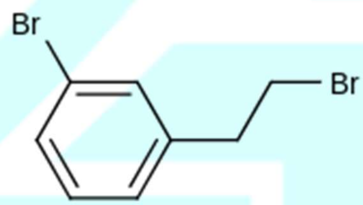
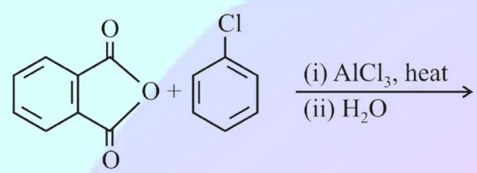


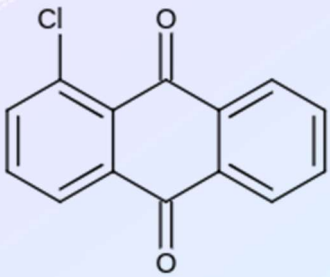
(4)



Q43. The major product of the following reaction is:



(1)



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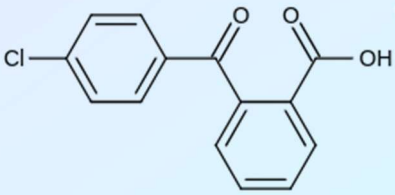
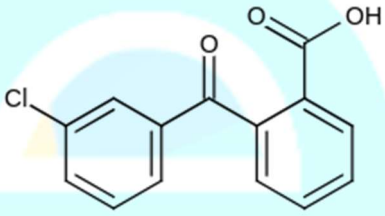
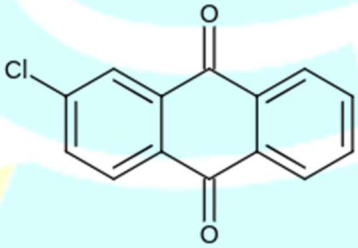


(3)



(4)



Q44. Which is wrong with respect to our responsibility as a human being to protect our environment?
(1) Using plastic bags.
(2) Restricting the use of vehicles
(3) Avoiding the use of floodlighted facilities
(4) Setting up compost tin in gardens

Q45. Assertion: Ozone is destroyed by CFCs in the upper stratosphere.
Reason: Ozone holes increase the amount of UV radiation reaching the earth.
(1) Assertion and reason are correct, but the reason is not the explanation for the assertion.
(2) The assertion is false, but the reason is correct.
(3) Assertion and reason are incorrect.
(4) Assertion and reason are both correct, and the reason is the correct explanation for the assertion.

Q46. Element B forms ccp structure and A occupies half of the octahedral voids, while oxygen atoms occupy all the tetrahedral voids. The structure of bimetallic oxide is:
(1) A_2BO_4
(2) AB_2O_4
(3) $A_2\ B_2O$
(4) $A_4\ B_2O$

Q47. The vapour pressures of pure liquids A and Bare 400 and 600 mm Hg respectively at 298 K . On mixing the two liquids, the sum of their volumes is equal to the volume of the final mixture. The mole fraction of liquid B is 0.5 in the mixture. The vapour pressure of the final solution, the mole fractions of components A and B in the vapour phase, respectively are
(1) 500 mmHg, 0.5,0.5
(2) 450 mmHg, 0.4,0.6
(3) 450 mmHg, 0.5,0.5
(4) 500 mmHg, 0.4,0.6

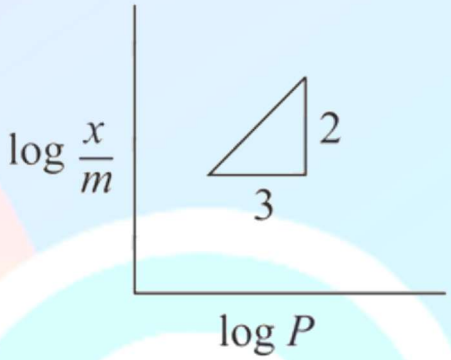
Q48. For the reaction $2A + B \rightarrow C$, the values of initial rate at different reactant concentrations are given in the table below. The rate law for the reactions is:

$[A](molL^{-1})$	$[B](molL^{-1})$	Initial Rate $(molL^{-1}\ s^{-1})$
0.05	0.05	0.045

0.10	0.05	0.090
0.20	0.10	0.72

(1) Rate = $k[A]^2[B]$
(2) Rate = $k[A]^2[B]^2$
(3) Rate = $k[A][B]$
(4) Rate = $k[A][B]^2$

Q49. Adsorption of a gas follows Freundlich adsorption isotherm. x is the mass of the gas adsorbed on mass m of the adsorbent. The plot of $\log\frac{x}{m}$ vs $\log p$ is shown in the given graph. $\frac{x}{m}$ is proportional to,



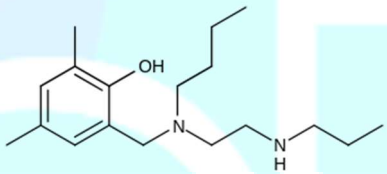
(1) p^3
(2) p^2
(3) $p^{2/3}$
(4) $p^{3/2}$

Q50. Which respect to an ore, Ellingham diagram helps to predict the feasibility of its
(1) Electrolysis
(2) Zone refining
(3) Vapour phase refining
(4) Thermal reduction

Q51. The lanthanide ion that would show colour is:
(1) Lu^{3+}
(2) La^{3+}
(3) Gd^{3+}
(4) Sm^{3+}

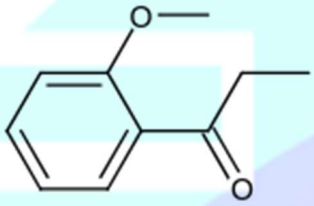
Q52. The correct order of the spin -only magnetic moment of metal ions in the following low-spin complexes, $[V(CN)_6]^{4-}, [Fe(CN)_6]^{4-}, [Ru(NH_3)_6]^{3+}$ and $[Cr(NH_3)_6]^{2+}$, is:
(1) $V^2+> Cr^{2+} > Ru^3 + 2 > Cre^{2++} > V^2+> Ru^{3+}(3)Cr^{2+} > Ru^{3+} > Fe^{2+}(4)W^{2+} > Ru^{3+} > Cr^{2+} > Fe^{2+}$

Q53. The following ligand is:

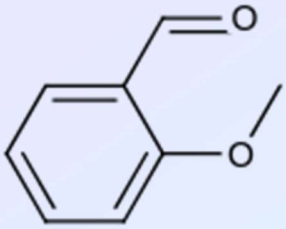


(1) tridentate
(2) hex dentate
(3) bidentate
(4) tetradentate

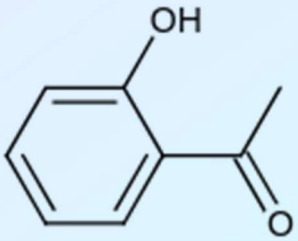
Q54. An organic compound neither reacts with neutral ferric chloride solution nor with Fehling solution. It however, reacts with Grignard reagent and given positive iodoform test. The compound is:
(1)



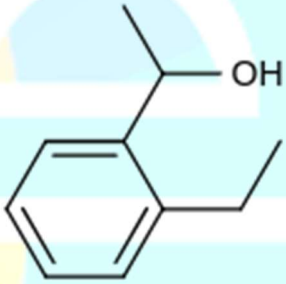
(2)



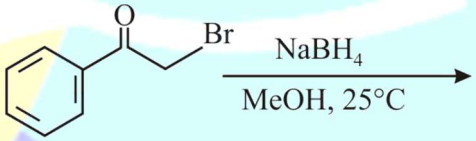
(3)



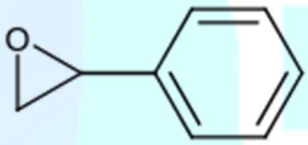
(4)



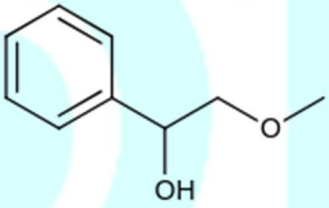
Q55. The major product of the following reaction is:



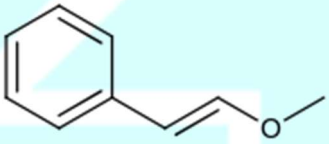
(1)



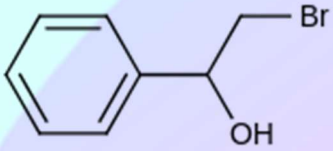
(2)



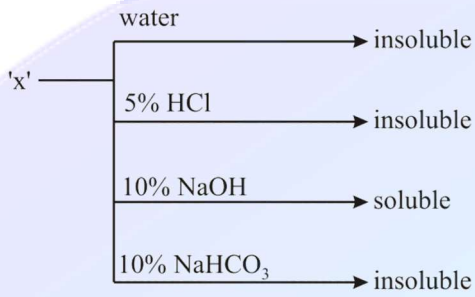
(3)



(4)



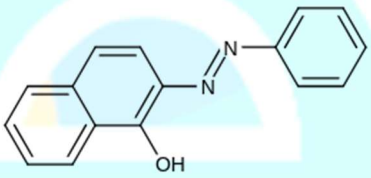
Q56. An organic compound ' X ' showing the following solubility profile is:



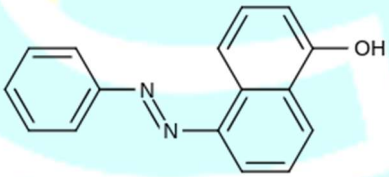
(1) m-Cresol
(2) o-Toluidine
(3) Oleic acid
(4) Benzamide

Q57. Which of the following amines can be prepared by Gabriel phthalimide reaction?
(1) t - butylamine
(2) n - butylamine
(3) triethylamine
(4) neo - pentylamine

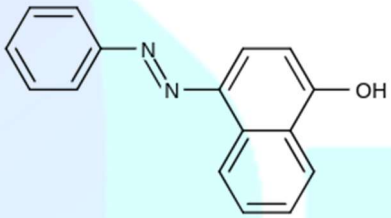
Q58. Coupling of benzene diazonium chloride with 1 - naphthol in alkaline medium will give:
(1)



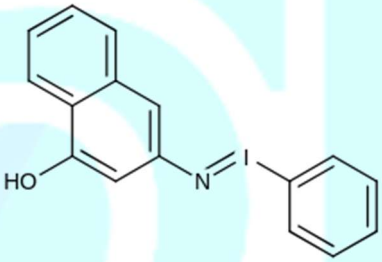
(2)



(3)



(4)



Q59. In the following compounds, the decreasing order of basic strength will be:
(1) $C_2H_5NH_2 > NH_3 > (C_2H_5)_2NH$
(2) $(C_2H_5)NH > NH_3 > C_2H_5NH_2$
(3) $NH_3 > C_2H_5NH_2 > (C_2H_5)_2NH$
(4) $(C_2H_5)_2NH > C_2H_5NH_2 > NH_3$

Q60. Maltose on treatment with dilute HCl gives:
(1) D-Glucose
(2) D-Fructose
(3) D-Galactose
(4) D-Glucose and DFructose

Q61. The sum of the solutions of the equation $\sqrt{x} - 2 + \sqrt{x}\sqrt{x} - 4 + 2 = 0, x > 0$ is equal to
(1) 10
(2) 9
(3) 12
(4) 4

Q62. If α and β be the roots of the equation $x^2 - 2x + 2 = 0$, then the least value of n for which $\frac{\alpha n}{\beta} = 1$ is
(1) 5
(2) 4

(3) 2
(4) 3

Q63. All possible numbers are formed using the digits 1,1,2,2,2,2,3,4,4 taken all at a time. The number of such numbers in which the odd digits occupy even places is
(1) 175
(2) 162
(3) 180
(4) 160

Q64. The sum of all natural numbers n such that $100 < n < 200$ and H.C.F. $91, n > 1$ is
(1) 3203
(2) 3221
(3) 3121
(4) 3303

Q65. The sum of the co-efficient of all even degree terms in x in the expansion of $x + \sqrt{x^3 - 1}^6 + x - \sqrt{x^3 - 1}^6, x > 1$ is equal to
(1) 26
(2) 32
(3) 24
(4) 29

Q66. The sum of the series $2.\ {}^{20}C_0 + 5.\ {}^{20}C_1 + 8.\ {}^{20}C_2 + 11.\ {}^{20}C_3 + \cdots\ldots + 62.\ {}^{20}C_{20}$ is equal to
(1) 2^{26}
(2) 2^{25}
(3) 2^{24}
(4) 2^{23}

Q67. If $\cos\alpha + \beta = \frac{3}{5}, \sin(\alpha - \beta) = \frac{5}{13}$ and $0 < \alpha, \beta < \frac{\pi}{4}$, then $\tan 2\alpha$ is equal to:
(1) $\frac{21}{16}$
(2) $\frac{63}{52}$
(3) $\frac{33}{52}$
(4) $\frac{63}{16}$

Q68. A point on the straight line, $3x + 5y = 15$ which is equidistant from the coordinate axes will lie only in:
(1) 1st and 2nd quadrants
(2) 1st, 2nd and 4th
(3) 1st quadrant
(4) 4th quadrant quadrants

Q69. The sum of the squares of the lengths of the chords intercepted on the circle, $x^2 + y^2 = 16$, by the lines, $x + y = n, n \in N$, where N is the set of all natural numbers is:
(1) 210
(2) 105
(3) 320
(4) 160

Q70. Let $O0,0$ and $A0,1$ be two fixed points. Then, the locus of a point P such that the perimeter of $\triangle AOP$ is 4 is
(1) $8x^2 + 9y^2 - 9y = 18$
(2) $9x^2 - 8y^2 + 8y = 16$
(3) $8x^2 - 9y^2 + 9y = 18$
(4) $9x^2 + 8y^2 - 8y = 16$

Q71. If the tangents on the ellipse $4x^2 + y^2 = 8$ at the points 1,2 and (a, b) are perpendicular to each other, then a^2 is equal to
(1) $\frac{2}{17}$
(2) $\frac{4}{17}$
(3) $\frac{64}{17}$
(4) $\frac{128}{17}$

Q72. $\lim_{x\to 0} \frac{\sin^2 x}{\sqrt{2} - \sqrt{1 + \cos x}}$ equals
(1) $4\sqrt{2}$
(2) $2\sqrt{2}$
(3) $\sqrt{2}$
(4) 4

Q73. The contrapositive of the statement "If you are born in India, then you are a citizen of India", is
(1) If you are not born in
(2) If you are a citizen of
(3) If you are born in India, then you are not a citizen of India.
(4) If you are not a citizen of India, then you are not born in India. India, then you are not a citizen of India. India, then you are born in India.

Q74. The mean and variance for seven observations are 8 and 16 respectively. If 5 of the observations are 2,4,10,12,14, then the product of the remaining two observations is
(1) 48
(2) 45

(3) 49
(4) 40

Q75. Let $A = \begin{matrix}\cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha\end{matrix}, a \in R$ such that $A^{32} = \begin{matrix}0 & -1 \\ 1 & 0\end{matrix}$. Then, a value of α is:
(1) 0
(2) $\frac{\pi}{16}$
(3) $\frac{\pi}{64}$
(4) $\frac{\pi}{32}$

Q76. The greatest value of $c \in R$ for which the system of linear equations $x - cy - cz = 0, cx - y + cz = 0, cx + cy - z = 0$ has a non-trivial solution, is
(1) -1
(2) 2
(3) $\frac{1}{2}$
(4) 0

Q77. If $\alpha = \cos^{-1}\frac{3}{5}, \beta = \tan^{-1}\frac{1}{3}$, where $0 < \alpha, \beta < \frac{\pi}{2}$, then $\alpha - \beta$ is equal to
(1) $\tan^{-1}\frac{9}{14}$
(2) $\cos^{-1}\frac{9}{5\sqrt{10}}$
(3) $\sin^{-1}\frac{9}{5\sqrt{10}}$
(4) $\tan^{-1}\frac{9}{5\sqrt{10}}$

Q78. If $fx = \log_e\frac{1-x}{1+x}, x < 1$, then $f\frac{2x}{1+x^2}$ is equal to
(1) fx^2
(2) $2fx^2$
(3) $-2fx$
(4) $2fx$

Q79. If $2y = \cot^{-1}\frac{\sqrt{3}\cos x + \sin x^2}{\cos x - \sqrt{3}\sin x}\ \forall x \in 0, \frac{\pi}{2}$, then $\frac{dy}{dx}$ is equal to
(1) $\frac{\pi}{6} - x$
(2) $2x - \frac{\pi}{3}$
(3) $x - \frac{\pi}{6}$
(4) None of these

Q80. The shortest distance between the line $y = x$ and the curve $y^2 = x - 2$ is
(1) $\frac{7}{4\sqrt{2}}$
(2) $\frac{7}{8}$
(3) $\frac{11}{4\sqrt{2}}$
(4) 2

Q81. If S_1 and S_2 are respectively the sets of local minimum and local maximum points of the function, $fx = 9x^4 + 12x^3 - 36x^2 + 25, x \in R$, then
(1) $S_1 = -2; S_2 = \{0,1\}$
(2) $S_1 = -1; S_2 = 0,2$
(3) $S_1 = -2,0; S_2 = \{1\}$
(4) $S_1 = -2,1; S_2 = \{0\}$

Q82. Let $f: 0,2 \to R$ be a twice differentiable function such that $f''x > 0$, for all $x \in 0, 2$. If $\phi x = fx + f2 - x$, then ϕ is
(1) decreasing on 0,2
(2) increasing on 0,2
(3) increasing on (0,1)
(4) decreasing on 0,1 and and decreasing on 1,2 increasing on (1,2)

Q83. $\int \frac{\sin\frac{5x}{2}}{\sin\frac{x}{2}}dx$, is equal to
(1) $x + 2\sin x + \sin 2x + c(2)$
(2) $2x + \sin x + \sin 2x + c(3)$
(3) $x + 2\sin x + 2\sin 2x + (4)$
$2x + \sin x + 2\sin 2x + c$

Q84. If $fx = \frac{2 - x\cos x}{2 + x\cos x}$ and $g(x) = \log_e x$, then the value of the integral $\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} gfxdx$ is
(1) $\log_e e$
(2) $\log_e 2$
(3) $\log_e 1$
(4) $\log_e 3$

Q85. The area (in sq. units) of the region $A = x, y \in R \times R0 \le x \le 3,0 \le y \le 4, y \le x^2 + 3x$ is
(1) $\frac{26}{3}$
(2) 8
(3) $\frac{53}{6}$
(4) $\frac{59}{6}$

Q86. Let $y = y(x)$ be the solution of the differential equation, $x^2 + 1^2\frac{dy}{dx} + 2x(x^2 + 1)y = 1$ such that $y0 = 0$. If $\sqrt{a}y1 = \frac{\pi}{32}$, then

the value of a is
(1) $\frac{1}{16}$
(2) $\frac{1}{2}$
(3) $\frac{1}{4}$
(4) 1

Q87. The magnitude of the projection of the vector $2\hat{\imath} + 3\hat{\jmath} + \hat{k}$ on the vector perpendicular to the plane containing the vectors $\hat{\imath} + \hat{\jmath} + \hat{k}$ and $\hat{\imath} + 2\hat{\jmath} + 3\hat{k}$, is:
(1) $3\sqrt{6}$
(2) $\sqrt{\frac{3}{2}}$
(3) $\sqrt{6}$
(4) $\frac{\sqrt{3}}{2}$

Q88. The length of the perpendicular from the point (2, -1, 4) on the straight line $\frac{x+3}{10} = \frac{y-2}{-7} = \frac{z}{1}$ is
(1) greater than 3 but less
(2) greater than 4
(3) less than 2
(4) greater than 2 but less than 3

Q89. The equation of a plane containing the line of intersection of the planes $2x - y - 4 = 0$ and $y + 2z - 4 = 0$ and passing through the point $1,1,0$ is
(1) $x - 3y - 2z = -2$
(2) $x + 3y + z = 4$
(3) $x - y - z = 0$
(4) $2x - z = 2$

Q90. Let A and B be two non-null events such that $A \subset B$. Then, which of the following statements is always correct?
(1) $PA \mid B \geq P(A)$
(2) $PA \mid B = PB - PA$
(3) $PA \mid B \leq P(A)$
(4) $PA \mid B = 1$

ANSWER KEYS

1. (3)	2. (2)	3. (3)	4. (1)	5. (2)	6. (3)	7. (4)	8. (1)
9. (4)	10. (2)	11. (2)	12. (2)	13. (4)	14. (3)	15. (3)	16. (2)
17. (1)	18. (4)	19. (1)	20. (2)	21. (2)	22. (4)	23. (1)	24. (2)
25. (3)	26. (1)	27. (4)	28. (2)	29. (1)	30. (4)	31. (2)	32. (1)
33. (4)	34. (2)	35. (2)	36. (2)	37. (2)	38. (4)	39. (3)	40. (4)
41. (4)	42. (1)	43. (2)	44. (1)	45. (1)	46. (2)	47. (4)	48. (4)
49. (3)	50. (4)	51. (4)	52. (1)	53. (4)	54. (4)	55. (1)	56. (1)
57. (2)	58. (3)	59. (4)	60. (1)	61. (1)	62. (2)	63. (3)	64. (3)
65. (3)	66. (2)	67. (4)	68. (1)	69. (1)	70. (4)	71. (1)	72. (1)
73. (4)	74. (1)	75. (3)	76. (3)	77. (3)	78. (4)	79. (4)	80. (1)
81. (4)	82. (4)	83. (1)	84. (3)	85. (4)	86. (1)	87. (2)	88. (1)
89. (3)	90. (1)						