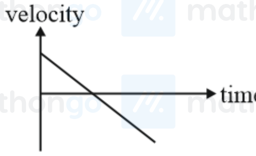
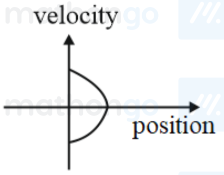
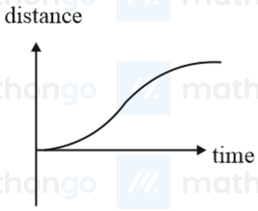
Q1. The density of a material, in the shape of a cube, is determined by measuring three sides of the cube and its mass. If the relative errors in measuring the mass and length are 1.5% and 1%, respectively, the maximum error in determining the density is:

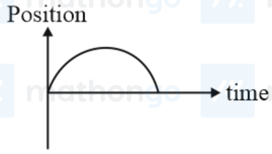
(1) 6 %
(2) 2.5 %
(3) 3.5 %
(4) 4.5 %

Q2. All the graphs below are intended to represent the same motion. One of them does it incorrectly. Pick it up.

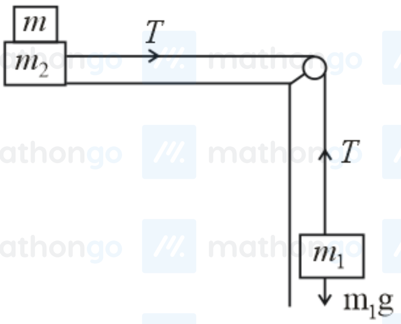
(1) 

(2) 

(3) 

(4) 

Q3. Two masses $m_1 = 5$ kg and $m_2 = 10$ kg, connected by an inextensible string over a frictionless pulley, are moving as shown in the figure. The coefficient of friction of horizontal surface is 0.15. The minimum weight m that should be put on top of m_2 to stop the motion is:



(1) 10.3 kg
(2) 18.3 kg
(3) 27.3 kg
(4) 43.3 kg

Q4. A particle is moving in a circular path of radius a under the action of an attractive potential $U = -\frac{k}{2r^2}$. Its total energy is:

(1) $-\frac{3}{2}\frac{k}{a^2}$
(2) $-\frac{k}{4a^2}$
(3) $\frac{k}{2a^2}$
(4) Zero

Q5. In a collinear collision, a particle with an initial speed v_0 strikes a stationary particle of the same mass. If the final total kinetic energy is 50% greater than the original kinetic energy, the magnitude of the relative velocity between the two particles, after the collision, is

(1) $\frac{v_0}{\sqrt{2}}$
(2) $\frac{v_0}{4}$
(3) $\sqrt{2}\, v_0$
(4) $\frac{v_0}{2}$

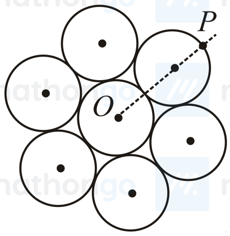
Q6. It is found that if a neutron suffers an elastic collinear collision with a deuterium at rest, the fractional loss of its energy is P_{d}, while for its similar collision with a carbon nucleus at rest, the fractional loss of energy is P_{c}. The values of P_{d} and P_{c} are respectively

(1) $0,\ 1$
(2) $0.89,\ 0.28$
(3) $0.28,\ 0.89$
(4) $0,\ 0$

Q7. The mass of a hydrogen molecule is 3.32×10^{-27} kg. If 10^{23} hydrogen molecules strike, per second, a fixed wall of the area $2\ \mathrm{cm}^2$ at an angle of 45^o to the normal, and rebound elastically with a speed of $10^3\ \mathrm{m\,s^{-1}}$, then the pressure on the wall is nearly:

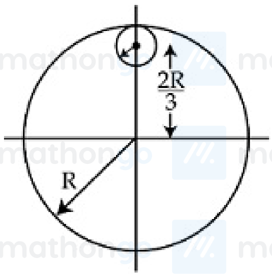
(1) $4.70 \times 10^2\ \mathrm{N\,m^{-2}}$
(2) $2.35 \times 10^3\ \mathrm{N\,m^{-2}}$
(3) $4.70 \times 10^3\ \mathrm{N\,m^{-2}}$
(4) $2.35 \times 10^2\ \mathrm{N\,m^{-2}}$

Q8. Seven identical circular planar disks, each of mass M and radius R are welded symmetrically as shown. The moment of inertia of the arrangement about the axis normal to the plane and passing through the point P is:



(1) $\frac{181}{2} MR^2$
(2) $\frac{19}{2} MR^2$
(3) $\frac{55}{2} MR^2$
(4) $\frac{73}{2} MR^2$

Q9. From a uniform circular disc of radius R and mass 9 M, a small disc of radius $\frac{R}{3}$ is removed as shown in the figure. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through centre of disc is:



(1) $\frac{37}{9} MR^2$
(2) $4MR^2$
(3) $\frac{40}{9} MR^2$
(4) $10MR^2$

Q10. A particle is moving with a uniform speed in a circular orbit of radius R in a central force inversely proportional to the n^{th} power of R. If the period of rotation of the particle is T, then:

(1) $T \propto R^{n/2}$
(2) $T \propto R^{3/2}$ for any n
(3) $T \propto R^{\frac{n}{2}+1}$
(4) $T \propto R^{\frac{n+1}{2}}$

Q11. A solid sphere of radius r made of a soft material of bulk modulus K is surrounded by a liquid in a cylindrical container. A massless piston of area a floats on the surface of the liquid, covering entire cross-section of cylindrical container. When a mass m is placed on the surface of the piston to compress the liquid, the fractional decrement in the radius of the sphere $\left(\frac{dr}{r}\right)$, is:

(1) $\frac{mg}{Ka}$
(2) $\frac{Ka}{mg}$
(3) $\frac{Ka}{3mg}$
(4) $\frac{mg}{3Ka}$

Q12. Two moles of an ideal monoatomic gas occupies a volume V at 27^oC . The gas expands adiabatically to a volume $2V$. Calculate (a) the final temperature of the gas and (b) change in its internal energy.

(1) $(a) 195 \text{ K} \ \ (b) 2.7 \text{ kJ}$
(2) $(a) 189 \text{ K} \ \ (b) 2.7 \text{ kJ}$
(3) $(a) 195 \text{ K} \ \ (b) -2.7 \text{ kJ}$
(4) $(a) 189 \text{ K} \ \ (b) -2.7 \text{ kJ}$

Q13. A silver atom in a solid oscillates in simple harmonic motion in some direction with a frequency of 10^{12} s^{-1} . What is the force constant of the bonds connecting one atom with the other? (Mole wt. of silver, $= 108 \text{ g mol}^{-1}$ and Avogadro number $= 6.02 \times 10^{23}$)

(1) 5.5 N m^{-1}
(2) 6.4 N m^{-1}
(3) 7.1 N m^{-1}
(4) 2.2 N m^{-1}

Q14. A granite rod of 60 cm length is clamped at its middle point and is set into longitudinal vibrations. The density of granite is $2.7 \times 10^3 \text{ kg m}^{-3}$ and its Young's modulus is $9.27 \times 10^{10} \text{ Pa}$. What will be the fundamental frequency of the longitudinal vibrations?

(1) 7.5 kHz
(2) 5 kHz
(3) 2.5 kHz
(4) 10 kHz

Q15. Three concentric metal shells A, B and C of respective radii a, b and c $(a < b < c)$ have surface charge densities $+\sigma, -\sigma$ and $+\sigma$ respectively. The potential of shell B is:

(1) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{c}+a\right]$
(2) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{a}+c\right]$
(3) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{b}+c\right]$
(4) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{b}+a\right]$

Q16. A parallel plate capacitor of capacitance 90 pF is connected to a battery of EMF 20 V. If a dielectric material of dielectric constant $K = \frac{5}{3}$ is inserted between the plates, the magnitude of the induced charge will be:

(1) 0.9 nC
(2) 1.2 nC
(3) 0.3 nC
(4) 2.4 nC

Q17. Two batteries with e.m.f. 12 V and 13 V are connected in parallel across a load resistor of $10 \ \Omega$. The internal resistance of the two batteries are $1 \ \Omega$ and $2 \ \Omega$ respectively. The voltage across the load lies between,

(1) 11.7 V and 11.8 V
(2) 11.6 V and 11.7 V
(3) 11.5 V and 11.6 V
(4) 11.4 V and 11.5 V

Q18. On interchanging the resistances, the balance point of a meter bridge shifts to the left by 10 cm. The resistance of their series combination is $1 \text{ k}\Omega$. How much was the resistance on the left slot before interchanging the resistances?

(1) $910 \ \Omega$
(2) $990 \ \Omega$
(3) $505 \ \Omega$
(4) $550 \ \Omega$

Q19. In a potentiometer experiment, it is found that no current passes through the galvanometer when the terminals of the cell are connected across 52 cm of the potentiometer wire. If the cell is shunted by a resistance of 5 Ω ,a balance is found when the cell is connected across 40 cm of the wire. Find the internal resistance of the cell.

(1) 2.5 Ω
(2) 1 Ω
(3) 1.5 Ω
(4) 2 Ω

Q20. The dipole moment of a circular loop carrying a current I, is m and the magnetic field at the centre of the loop is B_1. When the dipole moment is doubled by keeping the current constant, the magnetic field at the centre of the loop is B_2 . The ratio $\frac{B_1}{B_2}$ is:

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

Q21. An electron, a proton and an alpha particle having the same kinetic energy are moving in circular orbits of radii $r_e,\ r_p,\ r_\alpha$ respectively in a uniform magnetic field B. The relation between $r_e,\ r_p,\ r_\alpha$ is:

(1) $r_e < r_\alpha < r_p$
(2) $r_e > r_P = r_\alpha$
(3) $r_e < r_p = r_\alpha$
(4) $r_e < r_p < r_\alpha$

Q22. For an RLC circuit driven with voltage of amplitude v_m and frequency $\omega_0 = \frac{1}{\sqrt{LC}}$ the current exhibits resonance. The quality factor, Q is given by

(1) $\frac{CR}{\omega_0}$
(2) $\frac{\omega_0 L}{R}$
(3) $\frac{\omega_0 R}{L}$
(4) $\frac{R}{(\omega_0 C)}$

Q23. In an A.C. circuit, the instantaneous e.m.f. and current are given by, $E = 100 \sin 30t, I = 20 \sin\left(30t - \frac{\pi}{4}\right)$. In one cycle of A.C., the average power consumed by the circuit (in watt) and the watt-less current (in ampere) are, respectively:

(1) 50, 0
(2) 50, 10
(3) $\frac{1000}{\sqrt{2}}$, 10
(4) $\frac{50}{\sqrt{2}}$, 0

Q24. An EM wave from air enters a medium. The electric fields are $\overrightarrow{E_1} = E_{01}\widehat{x}\cos\left[2\pi v\left(\frac{z}{c} - t\right)\right]$ in air and $\overrightarrow{E_2} = E_{02}\widehat{x}\cos[k(2z - ct)]$in medium, where the wave number k and frequency v refer to their values in the air. The medium is non-magnetic. If ϵ_{r_1} and ϵ_{r_2} refer to relative permittivities of air and medium respectively, which of the following options, is correct?

(1) $\frac{\epsilon_{r_1}}{\epsilon_{r_2}} = \frac{1}{2}$
(2) $\frac{\epsilon_{r_1}}{\epsilon_{r_2}} = 4$
(3) $\frac{\epsilon_{r_1}}{\epsilon_{r_2}} = 2$
(4) $\frac{\epsilon_{r_1}}{\epsilon_{r_2}} = \frac{1}{4}$

Q25. Unpolarized light of intensity I passes through an ideal polariser A. Another identical polariser B is placed behind A. The intensity of light beyond B is found to be $\frac{I}{2}$. Now another identical polariser C is placed between A and B. The intensity beyond B is now found to be $\frac{I}{8}$. The angle between polariser A and C is

(1) 60°
(2) 0°
(3) 30°
(4) 45°

Q26. The angular width of the central maximum in a single slit diffraction pattern is 60° . The width of the slit is 1 μm. The slit is illuminated by monochromatic plane waves. If another slit of the same width is made near it, Young's fringes can be observed on a screen placed at a distance 50 cm from the slits. If the observed fringe width is 1 cm, what is slit separation distance? (i.e., the distance between the centres of each slit.)

(1) $100 \mu\text{m}$
(2) $25 \mu\text{m}$
(3) $50 \mu\text{m}$
(4) $75 \mu\text{m}$

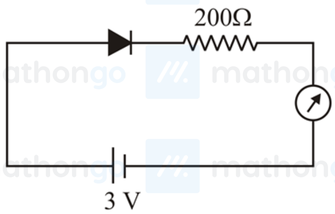
Q27. An electron from various excited states of hydrogen atom emit radiation to come to the ground state. Let λ_n, λ_g be the de Broglie wavelength of the electron in the n^{th} state and the ground state respectively. Let $\wedge_n$ be the wavelength of the emitted photon in the transition from the n^{th} state to the ground state. For large n, (A, B are constants)

(1) $\wedge_n^2 \approx \lambda$
(2) $\wedge_n \approx A + \frac{B}{\lambda_n^2}$
(3) $\wedge_n \approx A + B\lambda_n$
(4) $\wedge_n^2 \approx A + B\lambda_n^2$

Q28. If the series limit frequency of the Lyman series is V_L, then the series limit frequency of the Pfund series is:

(1) $\frac{V_L}{25}$
(2) $25\ V_L$
(3) $16\ V_L$
(4) $\frac{V_L}{16}$

Q29. The reading of the ammeter for a silicon diode in the given circuit is:



(1) 13.5 mA
(2) 0
(3) 15 mA
(4) 11.5 mA

Q30. A telephonic communication service is working at a carrier frequency of 10 GHz. Only 10% of it is utilized for transmission. How many telephonic channels can be transmitted simultaneously if each channel requires a bandwidth of 5 kHz?

(1) 2×10^6
(2) 2×10^3
(3) 2×10^4
(4) 2×10^5

Q31. The ratio of mass percent of C and H of an organic compound $(C_XH_YO_Z)$ is $6 : 1$. If one molecule of the above compound $(C_XH_YO_Z)$ contains half as much oxygen as required to burn one molecule of compound C_XH_Y completely to CO_2 and H_2O. The empirical formula of the compound $C_XH_YO_Z$ is

(1) $C_2H_4O_3$
(2) $C_3H_6O_3$
(3) C_2H_4O
(4) $C_3H_4O_2$

Q32. According to molecular orbital theory, which of the following molecule will not be available?

(1) H_2^{2-}
(2) He_2^{2+}
(3) He_2^{+}
(4) H_2^{-}

Q33. Which of the following compounds contain(s) no covalent bond(s)?

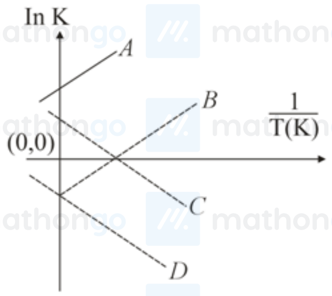
$KCl,\ PH_3,\ O_2,\ B_2H_6,\ H_2SO_4$

(1) $KCl,\ B_2H_6$
(2) $KCl,\ B_2H_6,\ PH_3$
(3) $KCl,\ H_2SO_4$
(4) KCl

Q34. Total number of lone pair of electrons in I_3^- ion is:
(1) 12
(2) 3
(3) 6
(4) 9

Q35. The combustion of benzene (l) gives $CO_2(g)$ and $H_2O(l)$. Given that heat of combustion of benzene at constant volume is $-3263.9\ \text{kJ mol}^{-1}$ at $25^\circ C$; the heat of combustion $\left(\text{in kJ mol}^{-1}\right)$ of benzene at constant pressure will be
$\left(R = 8.314\ \text{JK}^{-1}\ \text{mol}^{-1}\right)$
(1) -3267.6
(2) 4152.6
(3) -452.46
(4) 3260

Q36. Which of the following lines correctly show the temperature dependence of equilibrium constant K, for an exothermic reaction?



(1) A & D
(2) A & B
(3) B & C
(4) C & D

Q37. An aqueous solution contains $0.10\ M\ H_2S$ and $0.20\ M\ HCl$. If the equilibrium constant for the formation of HS^- from H_2S is 1.0×10^{-7} and that of S^{2-} from HS^- ions is 1.2×10^{-13}, then, the concentration of S^{2-} ions in the aqueous solution is:
(1) 5×10^{-19}
(2) 5×10^{-8}
(3) 3×10^{-20}
(4) 6×10^{-21}

Q38. An aqueous solution contains an unknown concentration of Ba^{2+}. When $50\ \text{mL}$ of a 1 M solution of Na_2SO_4 is added, $BaSO_4$ just begins to precipitate. The final volume is $500\ \text{mL}$. The solubility product of $BaSO_4$ is 1×10^{-10}. What is the original concentration of Ba^{2+}?
(1) $1.0 \times 10^{-10} M$
(2) $5 \times 10^{-9} M$
(3) $2 \times 10^{-9} M$
(4) $1.1 \times 10^{-9} M$

Q39. Which of the following are Lewis acids?
(1) BCl_3 and $AlCl_3$
(2) PH_3 and BCl_3
(3) $AlCl_3$ and CCl_4
(4) PH_3 and CCl_4

Q40. Which of the following salts is the most basic in aqueous solution?

(1) $Pb(CH_3COO)_2$ (2) $Al(CN)_3$
(3) CH_3COOK (4) $FeCl_3$

Q41. An alkali is titrated against acid with methyl orange as an indicator, which of the following is a correct combination?

(1)

Base	Acid	End point
Strong	Strong	Pink to colourless

(2)

Base	Acid	End point
Weak	Srtong	Colourless to pink

(3)

Base	Acid	End point
Strong	strong	Pinkish red to yellow

(4)

Base	Acid	End point
Weak	Strong	Yellow to pinkish red

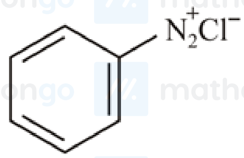
Q42. Hydrogen peroxide oxidises $[Fe(CN)_6]^{4-}$ to $[Fe(CN)_6]^{3-}$ in acidic medium, but reduces $[Fe(CN)_6]^{3-}$ to $[Fe(CN)_6]^{4-}$ in alkaline medium. The other products formed are, respectively

(1) H_2O and $(H_2O + OH^-)$ (2) $(H_2O + O_2)$ and H_2O
(3) $(H_2O + O_2)$ and $(H_2O + OH^-)$ (4) H_2O and $(H_2O + O_2)$

Q43. When metal M is treated with NaOH, a white gelatinous precipitate X is obtained, which is soluble in excess of NaOH. Compound X when heated strongly gives an oxide which is used in chromatography as an adsorbent. The metal M is

(1) Fe (2) Zn
(3) Ca (4) Al

Q44. Which of the following compounds will be suitable for Kjeldahl's method for nitrogen estimation?

(1)


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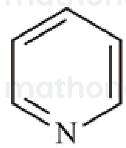

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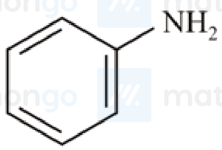

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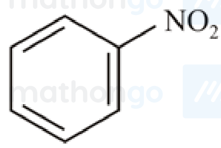


Q45. The trans-alkenes are formed by the reduction of alkynes with

(1) $Sn - HCl$ (2) $H_2 - Pd/C,\ BaSO_4$
(3) $NaBH_4$ (4) $Na/liq.\ NH_3$

Q46. The recommended concentration of fluoride ion in drinking water is up to 1 ppm as fluoride ion is required to make teeth enamel harder by converting $[3Ca_3(PO_4)_2 . Ca(OH)_2]$ to:

(1) $[3Ca(OH)_2 . CaF_2]$ (2) $[CaF_2]$
(3) $[3(CaF_2) . Ca(OH)_2]$ (4) $[3Ca_3(PO_4)_2 . CaF_2]$

Q47. Which type of 'defect' has the presence of cations in the interstitial sites?

(1) Metal deficiency defect (2) Schottky defect
(3) Vacancy defect (4) Frenkel defect

Q48. For 1 molal aqueous solution of the following compounds, which one will show the highest freezing point?

(1) $[Co(H_2O)_3Cl_3].3H_2O$
(2) $[Co(H_2O)_6]Cl_3$
(3) $[Co(H_2O)_5Cl]Cl_2.H_2O$
(4) $[Co(H_2O)_4Cl_2]Cl.2H_2O$

Q49. How long (approximate) should water be electrolysed by passing through 100 amperes current so that the oxygen released can completely burn 27.66 g of diborane? (Atomic weight of B = 10.8 u)
(1) 1.6 hours
(2) 6.4 hours
(3) 0.8 hours
(4) 3.2 hours

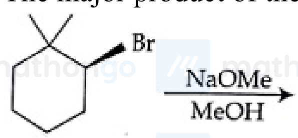
Q50. At 518°C, the rate of decomposition of a sample of gaseous acetaldehyde, initially at a pressure of 363 Torr was 1.00 Torr s^{-1} when 5% had reacted and 0.50 Torr s^{-1} when 33% had reacted. The order of the reaction is:
(1) 0
(2) 2
(3) 3
(4) 1

Q51. The compound that does not produce nitrogen gas by thermal decomposition is:
(1) $(NH_4)_2SO_4$
(2) $Ba(N_3)_2$
(3) $(NH_4)_2Cr_2O_7$
(4) NH_4NO_2

Q52. Consider the following reaction and statements:
$[Co(NH_3)_4Br_2]^+ + Br^- \rightarrow [Co(NH_3)_3Br_3] + NH_3$
(i) Two isomers are produced if the reactant complex ion is a cis-isomer.
(ii) Two isomers are produced if the reactant complex ion is a trans-isomer.
(iii) Only one isomer is produced if the reactant complex ion is a trans-isomer.
(iv) Only one isomer is produced if the reactant complex ion is a cis-isomer.
The correct statements are
(1) (ii) and (iv)
(2) (i) and (ii)
(3) (i) and (iii)
(4) (iii) and (iv)

Q53. The oxidation states of Cr in $[Cr(H_2O)_6]Cl_3$, $[Cr(C_6H_6)_2]$ and $K_2[Cr(CN)_2(O)_2(O_2)(NH_3)]$, respectively, are:
(1) +3, 0 and +4
(2) +3, +4 and +6
(3) +3, +2 and +4
(4) +3, 0 and +6

Q54. The major product of the following reaction is:



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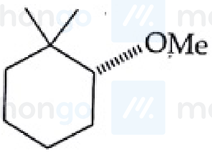

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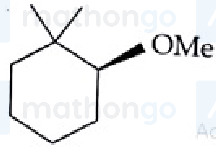

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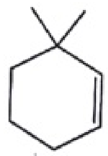

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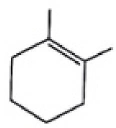
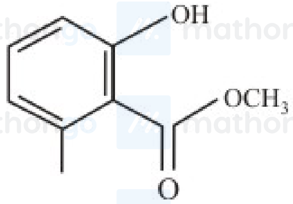
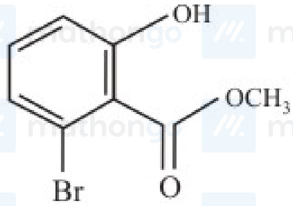
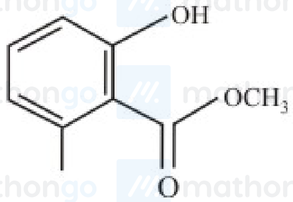
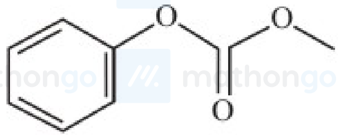
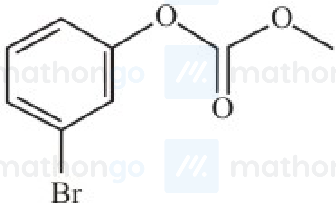
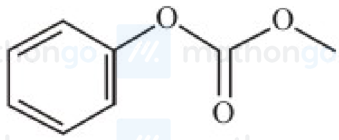
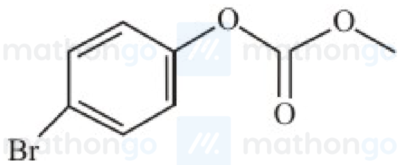


Q55. Phenol reacts with methyl chloroformate in the presence of NaOH to form product A. A reacts with Br_2 to form product B. A and B are respectively

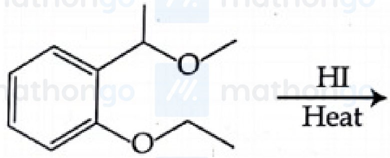
(1)  and 

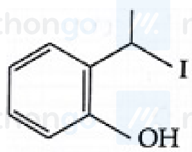
(2)  and 

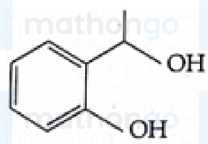
(3)  and 

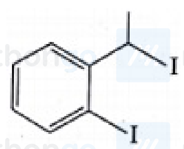
(4)  and 

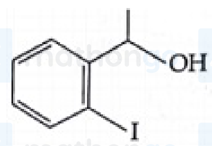
Q56. The major product formed in the following reaction is:



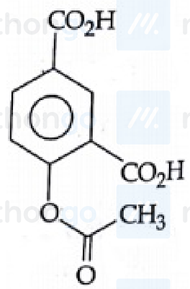
(1) 

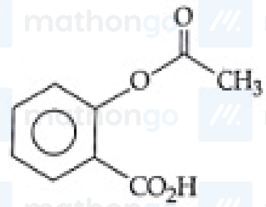
(2) 

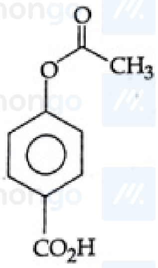
(3) 

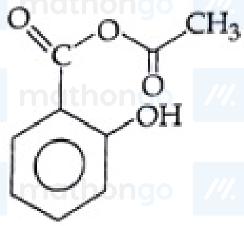
(4) 

Q57. Phenol on treatment with CO_2 in the presence of NaOH followed by acidification produces compound X as the major product. X on treatment with $(CH_3CO)_2$O in the presence of catalytic amount of H_2SO_4 produces:

(1) 

(2) 

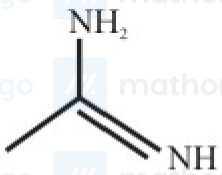
(3) 

(4) 

Q58. The increasing order of basicity of the following compounds is :

(i) 

(ii) 

(iii) 

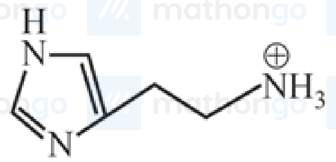
(iv) 

(1) (iv) < (ii) < (i) <(iii)
(2) (i) < (ii) < (iii) < (iv)
(3) (ii) < (i) < (iii) < (iv)
(4) (ii) < (i) < (iv) < (iii)

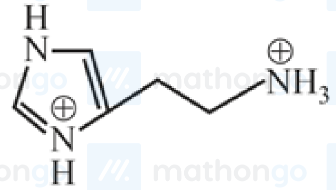
Q59. Glucose on prolonged heating with HI gives

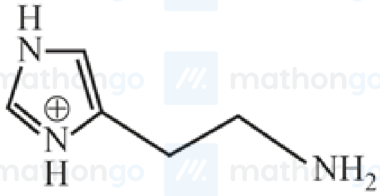
(1) 6−iodohexanal
(2) n−Hexane
(3) 1−Hexene
(4) Hexanoic acid

Q60. The predominant form of histamine present in human blood is $(\mathrm{pK_a},\ \mathrm{Histidine} = 60)$

(1) 

(2) 

(3) 

(4) 

Q61. Let $S = \left\{x \in R\ : x \geq 0\ \&\ 2\left|\sqrt{x} - 3\right| + \sqrt{x}\left(\sqrt{x} - 6\right) + 6 = 0\right\}$. Then S:

(1) Contains exactly four elements
(2) Is an empty set
(3) Contains exactly one element
(4) Contains exactly two elements

Q62. If $\alpha,\ \beta \in C$ are the distinct roots of the equation $x^2 - x + 1 = 0$, then $\alpha^{101} + \beta^{107}$ is equal to

(1) 2
(2) -1
(3) 0
(4) 1

Q63. From 6 different novels and 3 different dictionaries, 4 novels and 1 dictionary are to be selected and arranged in a row on a shelf so that the dictionary is always in the middle. The number of such arrangements is:

(1) At least 750 but less than 1000
(2) At least 1000
(3) Less than 500
(4) At least 500 but less than 750

Q64. Let A be the sum of the first 20 terms and B be the sum of the first 40 terms of the series
$1^2 + 2 \cdot 2^2 + 3^2 + 2 \cdot 4^2 + 5^2 + 2 \cdot 6^2 + \ldots$
If $B - 2A = 100\lambda$, then λ is equal to :

(1) 496
(2) 232
(3) 248
(4) 464

Q65. Let $a_1,\ a_2,\ a_3, \ldots\ldots, a_{49}$ be in $A.P.$ such that $\sum\limits_{k=0}^{12} a_{4k+1} = 416$ and $a_9 + a_{43} = 66$. If $a_1^2 + a_2^2 + \ldots + a_{17}^2 = 140m$, then m is equal to:

(1) 33
(2) 66
(3) 68
(4) 34

Q66. The sum of the co-efficient of all odd degree terms in the expansion of
$\left(x + \sqrt{x^3 - 1}\right)^5 + \left(x - \sqrt{x^3 - 1}\right)^5$, $(x > 1)$ is

(1) 2
(2) -1
(3) 0
(4) 1

Q67. If sum of all the solutions of the equation $8\cos x \cdot \left(\cos\left(\frac{\pi}{6} + x\right) \cdot \cos\left(\frac{\pi}{6} - x\right) - \frac{1}{2}\right) = 1$ in $[0,\ \pi]$ is $k\pi$, then k is equal to:

(1) $\frac{20}{9}$
(2) $\frac{2}{3}$
(3) $\frac{13}{9}$
(4) $\frac{8}{9}$

Q68. A straight line through a fixed point $(2, 3)$ intersects the coordinate axes at distinct points P and Q. If O is the origin and the rectangle $OPRQ$ is completed, then the locus of R is:
(1) $3x + 2y = 6xy$
(2) $3x + 2y = 6$
(3) $2x + 3y = xy$
(4) $3x + 2y = xy$

Q69. If the tangent at $(1, 7)$ to the curve $x^2 = y - 6$ touch the circle $x^2 + y^2 + 16x + 12y + c = 0$ then the value of c is:
(1) 95
(2) 195
(3) 185
(4) 85

Q70. Tangent and normal are drawn at $P(16, 16)$ on the parabola $y^2 = 16x$, which intersect the axis of the parabola at A & B, respectively. If C is the center of the circle through the points $P,\ A$ & B and $\angle CPB = \theta$, then a value of $\tan\theta$ is:
(1) $\frac{4}{3}$
(2) $\frac{1}{2}$
(3) 2
(4) 3

Q71. Two sets A and B are as under: $A = \{(a,\ b) \in R \times R\ : |a-5| < 1 \text{ and } |b-5| < 1\}$;
$B = \left\{(a,\ b) \in R \times R : 4(a-6)^2 + 9(b-5)^2 \le 36\right\}$. Then :
(1) neither $A \subset B$ nor $B \subset A$
(2) $B \subset A$
(3) $A \subset B$
(4) $A \cap B = \phi$ (an empty set)

Q72. Tangents are drawn to the hyperbola $4x^2 - y^2 = 36$ at the points P and Q. If these tangents intersect at the point $T(0,\ 3)$ then the area (in sq. units) of ΔPTQ is:
(1) $36\sqrt{5}$
(2) $45\sqrt{5}$
(3) $54\sqrt{3}$
(4) $60\sqrt{3}$

Q73. For each $t \in R$, let $[t]$ be the greatest integer less than or equal to t. Then $\lim\limits_{x \to 0^+} x\left(\left[\frac{1}{x}\right] + \left[\frac{2}{x}\right] + \ldots + \left[\frac{15}{x}\right]\right)$
(1) does not exist (in R)
(2) is equal to 0
(3) is equal to 15
(4) is equal to 120

Q74. The Boolean expression ~$(p \vee q) \vee$ (~$p \wedge q)$ is equivalent to
(1) ~q
(2) ~p
(3) p
(4) q

Q75. If $\sum_{i=1}^{9}(x_i - 5) = 9$ and $\sum_{i=1}^{9}(x_i - 5)^2 = 45$, then the standard deviation of the 9 items $x_1,\ x_2, \ldots, x_9$ is
(1) 3
(2) 9
(3) 4
(4) 2

Q76. PQR is a triangular park with $PQ = PR = 200$ m. A T.V. tower stands at the mid-point of QR. If the angles of elevation of the top of the tower at P, Q and R are respectively, $45^\circ,\ 30^\circ$ and 30°, then the height of the tower (in m) is:

(1) $50\sqrt{2}$
(2) 100
(3) 50
(4) $100\sqrt{3}$

Q77. Let the orthocentre and centroid of a triangle be $A(-3,\ 5)$ and $B(3,\ 3)$ respectively. If C is the circumcentre of this triangle, then the radius of the circle having line segment AC as diameter, is:

(1) $\frac{3\sqrt{5}}{2}$
(2) $\sqrt{10}$
(3) $2\sqrt{10}$
(4) $3\sqrt{\frac{5}{2}}$

Q78. If the system of linear equations

$x+ky+3z=0$
$3x+ky-2z=0$
$2x+4y-3z=0$

has a non-zero solution $(x,\ y,\ z)$, then $\frac{xz}{y^2}$ is equal to:

(1) 30
(2) -10
(3) 10
(4) -30

Q79. If $\begin{vmatrix} x-4 & 2x & 2x \\ 2x & x-4 & 2x \\ 2x & 2x & x-4 \end{vmatrix} = (A+Bx)\ (x-A)^2$, then the ordered pair $(A,\ B)$ is equal to

(1) $(4, 5)$
(2) $(-4,\ -5)$
(3) $(-4,\ 3)$
(4) $(-4,\ 5)$

Q80. Let $S=\left\{t\in R : f(x)=|x-\pi|\ \cdot\left(e^{|x|}-1\right)\sin|x| \text{ is not differentiable at } t\right\}$. Then, the set S is equal to:

(1) $\{0,\ \pi\}$
(2) ϕ (an empty set)
(3) $\{0\}$
(4) $\{\pi\}$

Q81. If the curves $y^2=6x,\ 9x^2+by^2=16$ intersect each other at right angles, then the value of b is:

(1) $\frac{9}{2}$
(2) 6
(3) $\frac{7}{2}$
(4) 4

Q82. Let $f(x)=x^2+\frac{1}{x^2}$ and $g(x)=x-\frac{1}{x},\ x\in R-\{-1,\ 0,\ 1\}$. If $h(x)=\frac{f(x)}{g(x)}$, then the local minimum value of $h(x)$ is:

(1) $2\sqrt{2}$
(2) 3
(3) -3
(4) $-2\sqrt{2}$

Q83. The integral $\int\frac{\sin^2x\cos^2x}{\left(\sin^5x+\cos^3x\sin^2x+\sin^3x\cos^2x+\cos^5x\right)^2}dx$, is equal to

(where C is the constant of integration).

(1) $\frac{-1}{1+\cot^3x}+C$
(2) $\frac{1}{3\left(1+\tan^3x\right)}+C$
(3) $\frac{-1}{3\left(1+\tan^3x\right)}+C$
(4) $\frac{1}{1+\cot^3x}+C$

Q84. The values of $\int\limits_{-\frac{\pi}{2}}^{\frac{\pi}{2}}\frac{\sin^2x}{1+2^x}dx$ is

(1) $\frac{\pi}{4}$
(2) $\frac{\pi}{8}$
(3) $\frac{\pi}{2}$
(4) 4π

Q85. Let $g(x) = \cos x^2,\ f(x) = \sqrt{x}$, and $\alpha, \beta(\alpha < \beta)$ be the roots of the quadratic equation $18x^2 - 9\pi x + \pi^2 = 0$. Then the area (in sq. units) bounded by the curve $y = (gof)(x)$ and the lines $x = \alpha, x = \beta$ and $y = 0$, is

(1) $\frac{1}{2}\left(\sqrt{2} - 1\right)$
(2) $\frac{1}{2}\left(\sqrt{3} - 1\right)$
(3) $\frac{1}{2}\left(\sqrt{3} + 1\right)$
(4) $\frac{1}{2}\left(\sqrt{3} - \sqrt{2}\right)$

Q86. Let $y = y(x)$ be the solution of the differential equation $\sin x \frac{dy}{dx} + y\cos x = 4x,\ x \in (0,\ \pi)$. If $y\left(\frac{\pi}{2}\right) = 0$, then $y\left(\frac{\pi}{6}\right)$ is equal to

(1) $-\frac{4}{9}\pi^2$
(2) $\frac{4}{9\sqrt{3}}\pi^2$
(3) $\frac{-8}{9\sqrt{3}}\pi^2$
(4) $-\frac{8}{9}\pi^2$

Q87. Let $\vec{u}$ be a vector coplanar with the vectors $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{b} = \hat{j} + \hat{k}$. If $\vec{u}$ is perpendicular to $\vec{a}$ and $\vec{u} \cdot \vec{b} = 24$, then $\left|\vec{u}\right|^2$ is equal to:

(1) 84
(2) 336
(3) 315
(4) 256

Q88. If L_1 is the line of intersection of the planes $2x - 2y + 3z - 2 = 0,\ x - y + z + 1 = 0$ and L_2 is the line of intersection of the planes $x + 2y - z - 3 = 0,\ 3x - y + 2z - 1 = 0$, then the distance of the origin from the plane, containing the lines L_1 and L_2 is

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

Q89. The length of the projection of the line segment joining the points $(5, -1,\ 4)$ and $(4, -1,\ 3)$ on the plane, $x + y + z = 7$ is

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

Q90. A bag contains 4 red and 6 black balls. A ball is drawn at random from the bag, its color is observed and this ball along with two additional balls of the same color are returned to the bag. If now a ball is drawn at random from the bag, then the probability that this drawn ball is red, is:

(1) $\frac{3}{4}$
(2) $\frac{3}{10}$
(3) $\frac{2}{5}$
(4) $\frac{1}{5}$

ANSWER KEYS

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