Q1. If $Z = \frac{A^2B^3}{C^4}$, then the relative error in Z will be

(1) $\frac{2\Delta A}{A} + \frac{3\Delta B}{B} + \frac{4\Delta C}{C}$ (2) $\frac{\Delta A}{A} + \frac{\Delta B}{B} + \frac{\Delta C}{C}$

(3) $\frac{2\Delta A}{A} + \frac{3\Delta B}{B} - \frac{4\Delta C}{C}$ (4) $\frac{\Delta A}{A} + \frac{\Delta B}{B} - \frac{\Delta C}{C}$

Q2. $\vec{A}$ is a vector quantity such that $\vec{A} =$ non-zero constant. Which of the following expression is true for $\vec{A}$?

(1) $\vec{A} \cdot \vec{A} = 0$ (2) $\vec{A} \times \vec{A} < 0$

(3) $\vec{A} \times \vec{A} = 0$ (4) $\vec{A} \times \vec{A} > 0$

Q3. Which of the following relations is true for two unit vector $\hat{A}$ and $\hat{B}$ making an angle θ to each other?

(1) $\hat{A} + \hat{B} = \hat{A} - \hat{B}\frac{\tan\theta}{2}$ (2) $\hat{A} - \hat{B} = \hat{A} + \hat{B}\frac{\tan\theta}{2}$

(3) $\hat{A} + \hat{B} = \hat{A} - \hat{B}\frac{\cos\theta}{2}$ (4) $\hat{A} - \hat{B} = \hat{A} + \hat{B}\frac{\cos\theta}{2}$

Q4. If force $\vec{F} = 3\hat{i} + 4\hat{j} - 2\hat{k}$ acts on a particle having position vector $2\hat{i} + \hat{j} + 2\hat{k}$ then, the torque about the origin will be:

(1) $-10\hat{i} + 10\hat{j} + 5\hat{k}$ (2) $3\hat{i} + 4\hat{j} - 2\hat{k}$

(3) $10\hat{i} + 5\hat{j} - 10\hat{k}$ (4) $10\hat{i} + \hat{j} - 5\hat{k}$

Q5. The height of any point P above the surface of earth is equal to diameter of earth. The value of acceleration due to gravity at point P will be : (Given $g =$ acceleration due to gravity at the surface of earth).

(1) $\frac{g}{2}$ (2) $\frac{g}{4}$

(3) $\frac{g}{3}$ (4) $\frac{g}{9}$

Q6. The terminal velocity v_t of the spherical rain drop depends on the radius r of the spherical rain drop as

(1) r (2) r^2

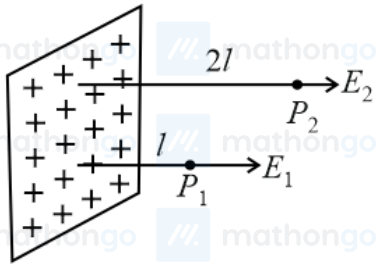
(3) $\frac{1}{r}$ (4) $\frac{1}{r^2}$

Q7. The relation between root mean square speed v_{rms} and most probable speed v_{p} for the molar mass M of oxygen gas molecule at the temperature of 300 K will be

(1) $v_{\text{rms}} = \sqrt{\frac{2}{3}}v_{\text{p}}$ (2) $v_{\text{rms}} = \sqrt{\frac{1}{3}}v_{\text{p}}$

(3) $v_{\text{rms}} = \sqrt{\frac{3}{2}}v_{\text{p}}$ (4) $v_{\text{rms}} = v_{\text{p}}$

Q8. In the figure, a very large plane sheet of positive charge is shown. P_1 and P_2 are two points at distance l and $2l$ from the charge distribution. If σ is the surface charge density, then the magnitude of electric fields E_1 and E_2 at P_1 and P_2 respectively are



(1) $E_1 = \frac{\sigma}{\varepsilon_o}, E_2 = \frac{\sigma}{2\varepsilon_o}$ (2) $E_1 = \frac{2\sigma}{\varepsilon_o}, E_2 = \frac{\sigma}{\varepsilon_o}$

(3) $E_1 = E_2 = \frac{\sigma}{2\varepsilon_o}$ (4) $E_1 = E_2 = \frac{\sigma}{\varepsilon_o}$

Q9. A teacher in his physics laboratory allotted an experiment to determine the resistance G a galvanometer. Students took the observations for $\frac{1}{3}$ deflection in the galvanometer. Which of the below is true for measuring value of G?

(1) $\frac{1}{3}$ deflection method cannot be used for determining the resistance of the galvanometer.

(2) $\frac{1}{3}$ deflection method can be used and in this case the G equals to twice the value of shunt resistance(s).

(3) $\frac{1}{3}$ deflection method can be used and in this case, the G equals to three times the value of shunt resistance(s).

(4) $\frac{1}{3}$ deflection method can be used and in this case the G value equals to the shunt resistance(s)

Q10. A long straight wire with a circular cross-section having radius R, is carrying a steady current I. The current I is uniformly distributed across this cross-section. Then the variation of magnetic field due to current I with distance $rr < R$ from its centre will be

(1) $B \propto r$ (2) $B \propto \frac{1}{r}$

(3) $B \propto r^2$ (4) $B \propto \frac{1}{r^2}$

Q11. Match List - I with List - II.

List-I	List-II
(A) AC generator	(I) Detects the presence of current in the circuit
(B) Galvanometer	(II) Converts mechanical energy into electrical energy
(C) Transformer	(III) Works on the principle of resonance in AC circuit
(D) Metal detector	(IV) Changes an alternating voltage for smaller or greater value

(1) A - II, B - I, C - IV, D - III (2) A - II, B - I, C - III, D - IV

(3) A - III, B - IV, C - II, D - I (4) A - III, B - I, C - II, D - IV

Q12. If wattless current flows in the AC circuit, then the circuit is :

(1) Purely Resistive circuit (2) Purely Inductive circuit

(3) LCR series circuit (4) RC series circuit only

Q13. The electric field in an electromagnetic wave is given by $E = 56.5\sin\omega\frac{t-x}{c}\text{NC}^{-1}$. Find the intensity of the wave if it is propagating along x-axis in the free space. (Given $\epsilon_0 = 8.85 \times 10^{-12}\text{C}^2 \quad \text{N}^{-1} \quad \text{m}^{-2}$)

(1) 5.65Wm^{-2} (2) $1.9 \times 10^{-7}\text{Wm}^{-2}$

(3) $4.24 \quad \text{Wm}^{-2}$ (4) 56.5Wm^{-2}

Q14. A light wave travelling linearly in a medium of dielectric constant 4, incidents on the horizontal interface separating medium with air. The angle of incidence for which the total intensity of incident wave will be reflected back into the same medium will be :

(Given : relative permeability of medium $\mu_r = 1$)

(1) 10° (2) 20°

(3) 30° (4) 60°

Q15. The difference of speed of light in the two media A and $B v_A$ - v_B is 2.6×10^7 m s^{-1}. If the refractive index of medium B is 1.47, then the ratio of refractive index of medium B to medium A is: (Given : speed of light in vacuum $c = 3 \times 10^8$ m s^{-1})

(1) 1.303 (2) 1.318

(3) 1.13 (4) 0.12

Q16. The two light beams having intensities I and $9I$ interfere to produce a fringe pattern on a screen. The phase difference between the beams is $\frac{\pi}{2}$ at point P and π at point Q. Then the difference between the resultant intensities at P and Q will be :

(1) $2I$ (2) $6I$

(3) $5I$ (4) $7I$

Q17. Given below are two statements :

Statement I : Davisson-Germer experiment establishes the wave nature of electrons.

Statement II : If electrons have wave nature, they can interfere and show diffraction.

In the light of the above statements choose the correct answer from the option given below :

(1) Both Statement I and Statement II are true. (2) Both Statement I and Statement II are false.

(3) Statement I is true but Statement II is false. (4) Statement I is false but Statement II is true.

Q18. The ratio for the speed of the electron in the 3^{rd} orbit of He^+ to the speed of the electron in the 3^{rd} orbit of hydrogen atom will be :

(1) $1:1$ (2) $1:2$

(3) $4:1$ (4) $2:1$

Q19. The photodiode is used to detect the optical signals. These diodes are preferably operated in reverse biased mode because

(1) fractional change in majority carriers produce higher forward bias current (2) fractional change in majority carriers produce higher reverse bias current

(3) fractional change in minority carriers produce higher forward bias current (4) fractional change in minority carriers produce higher reverse bias current

Q20. A signal of 100THz frequency can be transmitted with maximum efficiency by

(1) Coaxial cable (2) Optical fibre

(3) Twisted pair of copper wires (4) Water

Q21. A uniform chain of 6 m length is placed on a table such that a part of its length is hanging over the edge of the table. The system is at rest. The co-efficient of static friction between the chain and the surface of the table is 0.5, the maximum length of the chain hanging from the table is _____ m.

Q22. A force on an object of mass 100 g is $10\hat{i} + 5\hat{j}$ N. The position of that object at $t = 2$ s is $a\hat{i} + b\hat{j}$ m after starting from rest. The value of $\frac{a}{b}$ will be _____ .

Q23. A 0.5 kg block moving at a speed of 12 ms^{-1} compresses a spring through a distance 30 cm when its speed is halved. The spring constant of the spring will be _____ Nm^{-1}

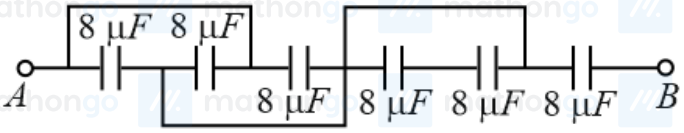
Q24. The velocity of upper layer of water in a river is 36 km h^{-1}. Shearing stress between horizontal layers of water is 10^{-3} N m^{-2}. Depth of the river is _____ m. (Co-efficient of viscosity of water is 10^{-2} Pa s)

Q25. A steam engine intakes 50 g of steam at 100°C per minute and cools it down to 20°C. If latent heat of vaporization of steam is 540 cal g^{-1}, then the heat rejected by the steam engine per minute is _____ $\times 10^3$ cal

(Given : specific heat capacity of water : 1 cal $g^{-1}°C^{-1}$)

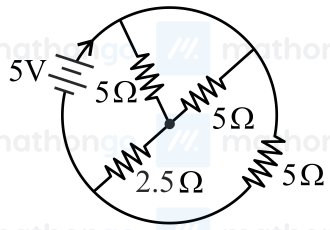
Q26. The first overtone frequency of an open organ pipe is equal to the fundamental frequency of a closed organ pipe. If the length of the closed organ pipe is 20 cm. The length of the open organ pipe is _____ cm

Q27. The equivalent capacitance between points A and B in below shown figure will be _____ μF.



Q28. A resistor develops 300 J of thermal energy in 15 s, when a current of 2 A is passed through it. If the current increases to 3 A, the energy developed in 10 s is _____ J.

Q29. The total current supplied to the circuit as shown in figure by the 5 V battery is _____ A.



Q30. The current in a coil of self inductance $L = 2.0$ H is increasing according to the law $i = 2\sin t^2$. Find the amount of energy spent (in J) during the period when the current changes from 0 to 2 A.

Q31. The pair, in which ions are isoelectronic with Al^{3+} is

(1) Br^- and Be^{2+}
(2) Cl^- and Li^+
(3) S^{2-} and K^+
(4) O^{2-} and Mg^{2+}

Q32. Bonding in which of the following diatomic molecule(s) become(s) stronger, on the basis of MO Theory, by removal of an electron?

(A) NO
(B) N_2
(C) O_2
(D) C_2
(E) B_2

Choose the most appropriate answer from the options given below :

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

Q33. Number of electron deficient molecules among the following $PH_3, B_2H_6, CCl_4, NH_3, LiH$ and BCl_3 is

(1) 0 (2) 1

(3) 2 (4) 3

Q34. Which one of the following alkaline earth metal ions has the highest ionic mobility in its aqueous solution?

(1) Sr^{2+} (2) Mg^{2+}

(3) Ca^{2+} (4) Be^{2+}

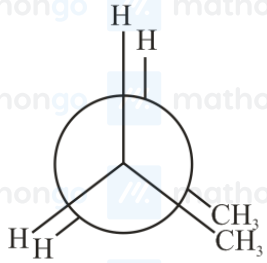
Q35. Phenol on reaction with dilute nitric acid, gives two products. Which method will be most efficient for large scale separation?

(1) Chromatographic separation (2) Steam distillation

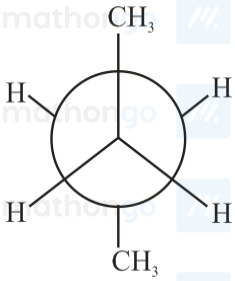
(3) Fractional Crystallisation (4) Sublimation

Q36. In the following structures, which one is having staggered conformation with maximum dihedral angle?

(1)



(2)



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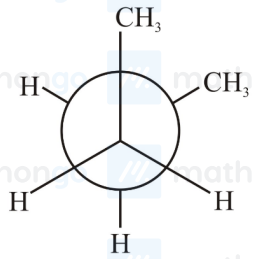
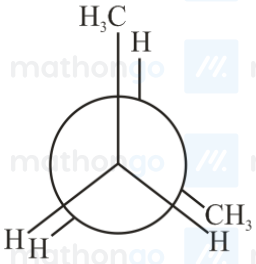


(4)

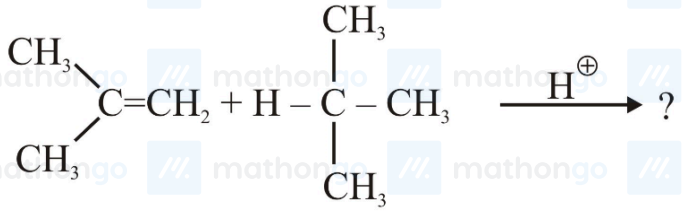


Q37. The IUPAC name of ethylidene chloride is

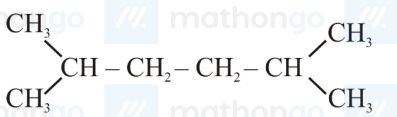
(1) 1 - chloroethene (2) 1, 2-dichloroethane

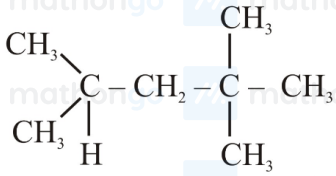
(3) 1, 1-dichloroethane (4) 1-chloroethyne

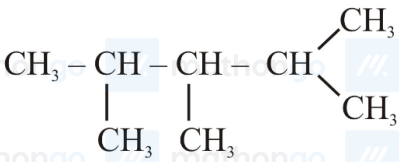
Q38. The product formed in the following reaction.

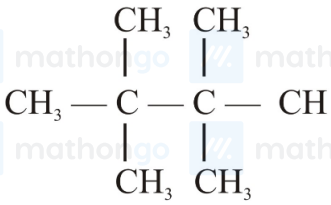


is:

(1) 

(2) 

(3) 

(4) 

Q39. The eutrophication of water body results in

(1) Increase in biodiversity
(2) Loss in biodiversity
(3) Break down of organic matter
(4) decrease in BOD.

Q40. Incorrect statement for Tyndall effect is

(1) The refractive indices of the dispersed phase and the dispersion medium differ greatly in magnitude.
(2) The diameter of the dispersed particles is much smaller than the wavelength of the light used.
(3) It is used to distinguish a true solution from a colloidal solution.
(4) During projection of movies in the cinemas hall, Tyndall effect is noticed.

Q41. Leaching of gold with dilute aqueous solution of NaCN in presence of oxygen gives complex A, which on reaction with zinc forms the elemental gold and another complex B. A and B, respectively are

(1) $AuCN_2^-$ and $ZnCN_4^{2-}$
(2) $AuCN_4^-$ and $ZnCN_2OH_2^{2-}$
(3) $AuCN_2^-$ and $ZnOH_4^{2-}$
(4) $AuCN_4^{2-}$ and $ZnCN_6^{4-}$

Q42. Cerium IV has a noble gas configuration. Which of the following is correct statement about it?

(1) It will prefer to gain electron and act as an oxidizing agent
(2) It will prefer to give away an electron and behave as reducing agent
(3) It will not prefer to undergo redox reactions.
(4) It acts as both, oxidizing and reducing agent.

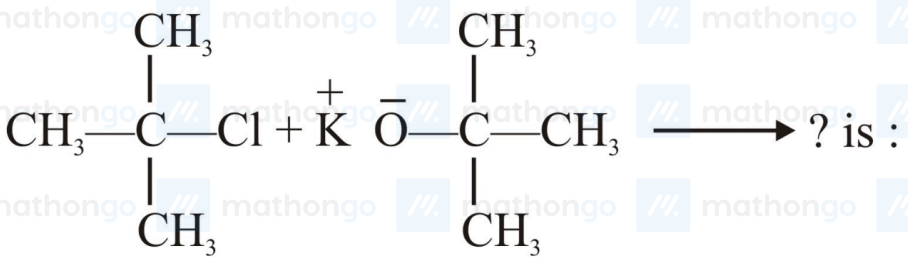
Q43. Among the following, which is the strongest oxidizing agent?

(1) Mn^{3+}
(2) Ti^{3+}
(3) Fe^{3+}
(4) Cr^{3+}

Q44. White precipitate of AgCl dissolves in aqueous ammonia solution due to formation of

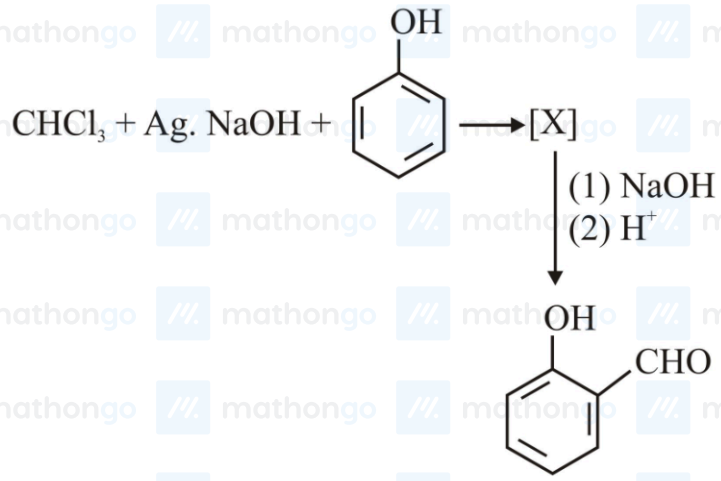
(1) $AgNH_{34}Cl_2$
(2) $AgCl_2NH_{32}$
(3) $AgNH_{32}Cl$
(4) $AgNH_3ClCl$

Q45. The major product in the reaction

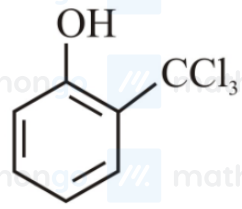


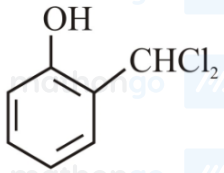
(1) *t*-Butyl ethyl ether
(2) 2 -Methyl pent-1-ene
(3) 2, 2 -Dimethyl butane
(4) 2 -Methyl prop-1-ene

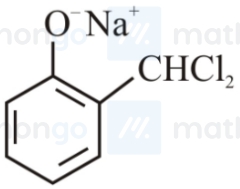
Q46. The intermediate X, in the reaction

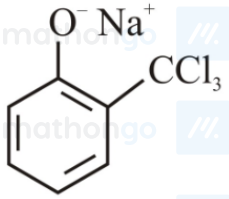


is :

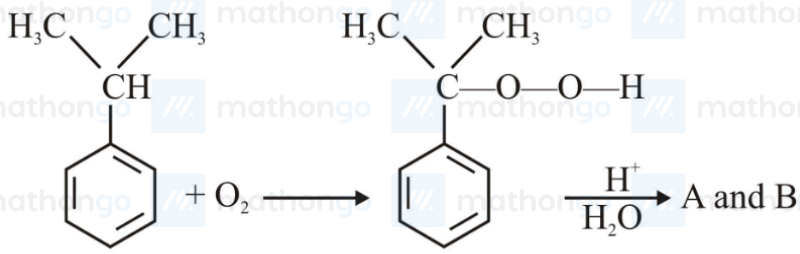
(1) 

(2) 

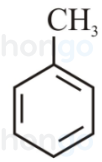
(3) 

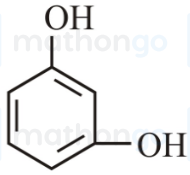
(4) 

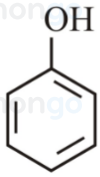
Q47. In the following reaction :

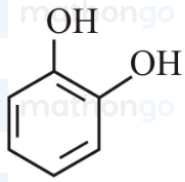


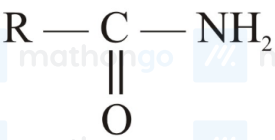
The compounds A and B respectively are

(1)  , CH_3COOH

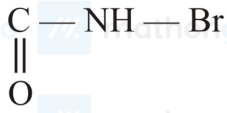
(2)  , CH_3COCH_3

(3)  , CH_3COCH_3

(4)  , CH_3COCH_3

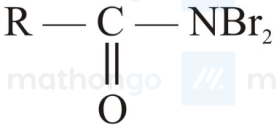
Q48. 

The reaction of with bromine and KOH gives RNH_2 as the end product. Which one of the following is the intermediate product formed in this reaction?

(1) 

(2) R - NH - Br

(3) R - N = C = O

(4) 

Q49. Using very little soap while washing clothes, does not serve the purpose of cleaning of clothes, because

(1) soap particles remain floating in water as ions.

(2) colloidal structure of soap in water is completely disturbed.

(3) the hydrophobic part of soap is not able to take away grease.

(4) the micelles are not formed due to concentration of soap, below its CMC value.

Q50. Which one of the following is an example of artificial sweetner?

(1) Bithional

(2) Alitame

(3) Lactose

(4) Salvarsan

Q51. The number of N atoms in 681 g of $C_7H_5N_3O_6$ is $x \times 10^{21}$. The value of x is $N_A = 6.02 \times 10^{23}$ mol^{-1} (Nearest Integer)

Q52. 1 L aqueous solution of H_2SO_4 contains 0.02 m mol H_2SO_4. 50% of this solution is diluted with deionized water to give 1 L solution A. In solution A, 0.01 m mol of H_2SO_4 are added. Total m mols of H_2SO_4 in the final solution is____ $\times 10^{-3}$ m moles.

Q53. Number of grams of bromine that will completely react with 5.0 g of pent-1-ene is____ $\times 10^{-2}$ g. (Atomic mass of Br = 80 g / mol) [Nearest integer]

Q54. The longest wavelength of light that can be used for the ionisation of lithium ion $\mathrm{(Li^{2+})}$ is $x \times 10^{-8}$ m. The value of x is (Nearest Integer)
(Given : Energy of the electron in the first shell of the hydrogen atom is -2.2×10^{-18} J; $h = 6.63 \times 10^{-34}$ Js and $c = 3 \times 10^{8}$ ms^{-1})

Q55. The standard entropy change for the reaction
$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$ is -550 J K^{-1} at 298 K
[Given : The standard enthalpy change for the reaction is -165 kJ mol^{-1}]. The temperature in K at which the reaction attains equilibrium is (Nearest Integer)

Q56. The standard free energy change $\Delta G°$ for 50% dissociation of N_2O_4 into NO_2 at 27 °C and 1 atm pressure is -x J mol^{-1}. The value of x is -. . . . . J. (Nearest Integer)
[Given : R = 8.31 J K^{-1} mol^{-1}, log1.33 = 0.1239 ln10 = 2.3]

Q57. The distance between Na^+ and Cl^- ions in solid NaCl of density 43.1 gcm^{-3} is . . . . . $\times 10^{-10}$ m. (Nearest Integer)
(Given : $N_A = 6.02 \times 10^{23}$ mol^{-1})

Q58. In a cell, the following reactions take place
$Fe^{2+} \rightarrow Fe^{3+} + e^-$ $E°_{Fe^{3+}/Fe^{2+}} = 0.77$ V
$2I^- \rightarrow I_2 + 2e^-$ $E°_{I_2/I^-} = 0.54$ V
The standard electrode potential for the spontaneous reaction in the cell is $x \times 10^{-2}$ V at 298 K. The value of x is - (Nearest Integer)

Q59. For a given chemical reaction $\gamma_1 A + \gamma_2 B \rightarrow \gamma_3 C + \gamma_4 D$. Concentration of C changes from 10 mmol dm^{-3} to 20 mmol dm^{-3} in 10 s. Rate of appearance of D is 1.5 times the rate of disappearance of B which is twice the rate of disappearance A. The rate of appearance of D has been experimentally determined to be 9 mmol $dm^{-3}s^{-1}$. Therefore the rate of reaction is____mmol $dm^{-3}s^{-1}$. (Nearest Integer)

Q60. If $CuH_2O_4^{2+}$ absorbs a light of wavelength 600 nm for d - d transition, then the value of octahedral crystal field splitting energy for $CuH_2O_6^{2+}$ will be____ $\times 10^{-21}$ J [Nearest integer]
(Given : $h = 6.63 \times 10^{-34}$ Js and $c = 3.08 \times 10^{8}$ ms^{-1})

Q61. Let a circle C in complex plane pass through the points $z_1 = 3 + 4i, z_2 = 4 + 3i$ and $z_3 = 5i$. If $z \neq z_1$ is a point on C such that the line through z and z_1 is perpendicular to the line through z_2 and z_3, then arg$z$ is equal to

(1) $\tan^{-1}\frac{24}{7} - \pi$ (2) $\tan^{-1}\frac{2}{\sqrt{5}} - \pi$

(3) $\tan^{-1}3 - \pi$ (4) $\tan^{-1}\frac{3}{4} - \pi$

Q62. If $\frac{1}{2\cdot 3^{10}}+\frac{1}{2^2\cdot 3^9}+\ldots+\frac{1}{2^{10}\cdot 3}=\frac{K}{2^{10}\cdot 3^{10}}$, then the remainder when K is divided by 6 is

(1) 2 (2) 3

(3) 4 (4) 5

Q63. Let a circle C touch the lines $L_1: 4x - 3y + K_1 = 0$ and $L_2: 4x - 3y + K_2 = 0$, K_1, $K_2 \in R$. If a line passing through the centre of the circle C intersects L_1 at $-1, 2$ and L_2 at $3, -6$, then the equation of the circle C is

(1) $x - 1^2 + y - 2^2 = 4$ (2) $x - 1^2 + y + 2^2 = 16$

(3) $x + 1^2 + y - 2^2 = 4$ (4) $x - 1^2 + y - 2^2 = 16$

Q64. If $y = m_1x + c_1$ and $y = m_2x + c_2$, $m_1 \neq m_2$ are two common tangents of circle $x^2 + y^2 = 2$ and parabola $y^2 = x$, then the value of $8\ m_1\ m_2$ is equal to

(1) $3\sqrt{2} - 4$ (2) $6\sqrt{2} - 4$

(3) $-5 + 6\sqrt{2}$ (4) $3 + 4\sqrt{2}$

Q65. Let $x = 2t, y = \frac{t^2}{3}$ be a conic. Let S be the focus and B be the point on the axis of the conic such that $SA \perp BA$, where A is any point on the conic. If k is the ordinate of the centroid of the ΔSAB, then $\lim\limits_{t \to 1} k$ is equal to

(1) $\frac{17}{18}$ (2) $\frac{19}{18}$

(3) $\frac{11}{18}$ (4) $\frac{13}{18}$

Q66. Let fx be a polynomial function such that $fx + f'x + f''x = x^5 + 64$. Then, the value of $\lim\limits_{x \to 1} \frac{fx}{x - 1}$ is equal to

(1) -15 (2) 15

(3) -60 (4) 60

Q67. Consider the following two propositions :

$P_1: \sim p \to \sim q$

$P_2: p \wedge \sim q \wedge \sim p \vee q$

If the proposition $p \to \sim p \vee q$ is evaluated as FALSE, then

(1) P_1 is TRUE and P_2 is FALSE (2) P_1 is FALSE and P_2 is TRUE

(3) Both P_1 and P_2 are FALSE (4) Both P_1 and P_2 are TRUE

Q68. Let a, b and c be the length of sides of a triangle ABC such that $\frac{a+b}{7} = \frac{b+c}{8} = \frac{c+a}{9}$. If r and R are the radius of incircle and radius of circumcircle of the triangle ABC, respectively, then the value of $\frac{R}{r}$ is equal to

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

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

Q69. Let $A = \begin{matrix} 0 & -2 \\ 2 & 0 \end{matrix}$. If M and N are two matrices given by $M = \sum_{k=1}^{10} A^{2k}$ and $N = \sum_{k=1}^{10} A^{2k-1}$ then MN^2 is

(1) a non-identity symmetric matrix (2) a skew-symmetric matrix

(3) neither symmetric nor skew-symmetric matrix (4) an identity matrix

Q70. Let A be a 3×3 real matrix such that $A \begin{matrix}1\\1\\0\end{matrix} = \begin{matrix}1\\1\\0\end{matrix}$; $A \begin{matrix}1\\0\\1\end{matrix} = \begin{matrix}-1\\0\\1\end{matrix}$ and $A \begin{matrix}0\\0\\1\end{matrix} = \begin{matrix}1\\1\\2\end{matrix}$. If $X = x_1 \quad x_2 \quad x_3{}^T$ and I is an identity matrix of order 3, then the system $A - 2IX = \begin{matrix}4\\1\\1\end{matrix}$ has

(1) no solution
(2) infinitely many solutions
(3) unique solution
(4) exactly two solutions

Q71. Let $f: N \to R$ be a function such that $fx + y = 2 \quad fx \quad fy$ for natural numbers x and y. If $f1 = 2$, then the value of α for which $\sum_{k=1}^{10} f\alpha + k = \frac{512}{3}2^{20} - 1$ holds, is

(1) 3
(2) 4
(3) 5
(4) 6

Q72. Let $f: R \to R$ be defined as $fx = x^3 + x - 5$. If gx is a function such that $fgx = x, \forall x \in R$, then $g'63$ is equal to _____

(1) 49
(2) $\frac{1}{49}$
(3) $\frac{43}{49}$
(4) $\frac{3}{49}$

Q73. Let $f: R \to R$ and $g: R \to R$ be two functions defined by $fx = \log_e x^2 + 1 - e^{-x} + 1$ and $gx = \frac{1 - 2e^{2x}}{e^x}$. Then, for which of the following range of α, the inequality $fg\frac{\alpha - 1^2}{3} > fg\alpha - \frac{5}{3}$ holds?

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

Q74. Let $g: 0, \infty \to R$ be a differentiable function such that $\int \frac{x\cos x - \sin x}{e^x + 1} + \frac{gxe^x + 1 - xe^x}{e^x + 1^2}dx = \frac{xgx}{e^x + 1} + C$, for all $x > 0$, where C is an arbitrary constant. Then

(1) g is decreasing in $0, \frac{\pi}{4}$
(2) $g - g'$ is increasing in $0, \frac{\pi}{2}$
(3) g' is increasing in $0, \frac{\pi}{4}$
(4) $g + g'$ is increasing in $0, \frac{\pi}{2}$

Q75. The value of $\int_0^{\pi} \frac{e^{\cos x}\sin x}{1 + \cos^2 x e^{\cos x} + e^{-\cos x}}dx$ is equal to

(1) $\frac{\pi^2}{4}$
(2) $\frac{\pi}{4}$
(3) $\frac{\pi}{6}$
(4) $\frac{\pi^2}{2}$

Q76. Let $y = yx$ be the solution of the differential equation $x + 1y' - y = e^{3x}x + 1^2$, with $y0 = \frac{1}{3}$. Then, the point $x = -\frac{4}{3}$ for the curve $y = yx$ is

(1) not a critical point
(2) a point of local minima
(3) a point of local maxima
(4) a point of inflection

Q77. If the solution curve $y = yx$ of the differential equation $y^2 \quad dx + x^2 - xy + y^2dy = 0$, which passes through the point $1, 1$ and intersects the line $y = \sqrt{3}x$ at the point $\alpha, \sqrt{3}\alpha$, then value of $\log_e \sqrt{3}\alpha$ is equal to

(1) $\frac{\pi}{2}$
(2) $\frac{\pi}{4}$
(3) $\frac{\pi}{6}$
(4) $\frac{\pi}{12}$

Q78. Let $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}, \quad a_i > 0, \quad i = 1, 2, 3$ be a vector which makes equal angles with the coordinate axes OX, OY and OZ. Also, let the projection of $\vec{a}$ on the vector $3\hat{i} + 4\hat{j}$ be 7 . Let $\vec{b}$ be a vector obtained by rotating $\vec{a}$ with 90°. If $\vec{a}, \vec{b}$ and x-axis are coplanar, then projection of a vector $\vec{b}$ on $3\hat{i} + 4\hat{j}$ is equal to

(1) $\sqrt{7}$ (2) $\sqrt{2}$

(3) 2 (4) 7

Q79. Let Q be the mirror image of the point $P1, 0, 1$ with respect to the plane $S: x + y + z = 5$. If a line L passing through $1, -1, -1$, parallel to the line PQ meets the plane S at R, then QR^2 is equal to

(1) 2 (2) 5

(3) 7 (4) 11

Q80. Let E_1 and E_2 be two events such that the conditional probabilities $PE_1 \mid E_2 = \frac{1}{2}, PE_2 \mid E_1 = \frac{3}{4}$ and $PE_1 \cap E_2 = \frac{1}{8}$. Then

(1) $PE_1 \cap E_2 = PE_1 \cdot PE_2$ (2) $PE_1' \cap E_2' = PE_1' \cdot PE_2$

(3) $PE_1 \cap E_2' = PE_1 \cdot PE_2$ (4) $PE_1 \cup E_2 = PE_1PE_2$

Q81. For a natural number n, let $\alpha_n = 19^n - 12^n$. Then, the value of $\frac{31\alpha_9 - \alpha_{10}}{57\alpha_8}$ is _____

Q82. The number of 3-digit odd numbers, whose sum of digits is a multiple of 7, is _____.

Q83. The greatest integer less than or equal to the sum of first 100 terms of the sequence $\frac{1}{3}, \frac{5}{9}, \frac{19}{27}, \frac{65}{81}, \ldots$ is equal to _____

Q84. Let C_r denote the binomial coefficient of x^r in the expansion of $1 + x^{10}$. If for $\alpha, \beta \in R$, $C_1 + 3 \cdot 2C_2 + 5 \cdot 3C_3 + \ldots$ upto 10 terms $= \frac{\alpha \times 2^{11}}{2^\beta - 1}\left(C_0 + \frac{C_1}{2} + \frac{C_2}{3} + \ldots \text{ upto 10 terms}\right)$ then the value of $\alpha + \beta$ is equal to _____.

Q85. The number of values of x in the interval $\frac{\pi}{4}, \frac{7\pi}{4}$ for which $14\,\text{cosec}^2\, x - 2\sin^2 x = 21 - 4\cos^2 x$ holds, is _____.

Q86. Let the abscissae of the two points P and Q be the roots of $2x^2 - rx + p = 0$ and the ordinates of P and Q be the roots of $x^2 - sx - q = 0$. If the equation of the circle described on PQ as diameter is $2x^2 + y^2 - 11x - 14y - 22 = 0$, then $2r + s - 2q + p$ is equal to _____.

Q87. Let A be a 3×3 matrix having entries from the set $-1, 0, 1$. The number of all such matrices A having sum of all the entries equal to 5, is _____

Q88. Let $f: R \to R$ be a function defined by $fx = 21 - \frac{x^{25}}{2}2 + x^{25}{}^{\frac{1}{50}}$. If the function $gx = fffx + ffx$, then the greatest integer less than or equal to $g1$ is _____.

Q89. Let θ be the angle between the vectors $\vec{a}$ and $\vec{b}$, where $\vec{a} = 4, \vec{b} = 3$ and $\theta \in \frac{\pi}{4}, \frac{\pi}{3}$. Then $\vec{a} - \vec{b} \times \vec{a} + \vec{b}^2 + 4\vec{a} \cdot \vec{b}^2$ is equal to _____

Q90. Let the lines $L_1: \vec{r} = \lambda\hat{i} + 2\hat{j} + 3\hat{k}, \quad \lambda \in R$ and $L_2: \vec{r} = \hat{i} + 3\hat{j} + \hat{k} + \mu\left(\hat{i} + \hat{j} + 5\hat{k}\right); \quad \mu \in R$, intersect at the point S. If a plane $ax + by - z + d = 0$ passes through S and is parallel to the lines L_1 and L_2, then the value of

$a + b + d$ is equal to _____.

ANSWER KEYS

1. (1)	**2.** (3)	**3.** (2)	**4.** (1)	**5.** (4)	**6.** (2)	**7.** (3)	**8.** (3)
9. (2)	**10.** (1)	**11.** (1)	**12.** (2)	**13.** (3)	**14.** (4)	**15.** (3)	**16.** (2)
17. (1)	**18.** (4)	**19.** (4)	**20.** (2)	**21.** (2)	**22.** (2)	**23.** (600)	**24.** (100)
25. (31)	**26.** (80)	**27.** (6)	**28.** (450)	**29.** (2)	**30.** (4)	**31.** (4)	**32.** (3)
33. (3)	**34.** (1)	**35.** (2)	**36.** (2)	**37.** (3)	**38.** (2)	**39.** (2)	**40.** (2)
41. (1)	**42.** (1)	**43.** (1)	**44.** (3)	**45.** (4)	**46.** (3)	**47.** (3)	**48.** (3)
49. (4)	**50.** (2)	**51.** (5418)	**52.** (20)	**53.** (1143)	**54.** (4)	**55.** (300)	**56.** (710)
57. (1)	**58.** (23)	**59.** (1)	**60.** (766)	**61.** (1)	**62.** (4)	**63.** (2)	**64.** (1)
65. (4)	**66.** (1)	**67.** (3)	**68.** (3)	**69.** (1)	**70.** (2)	**71.** (2)	**72.** (2)
73. (2)	**74.** (2)	**75.** (2)	**76.** (2)	**77.** (4)	**78.** (2)	**79.** (2)	**80.** (3)
81. (4)	**82.** (63)	**83.** (98)	**84.** (286)	**85.** (4)	**86.** (7)	**87.** (414)	**88.** (2)
89. (576)	**90.** (5)						