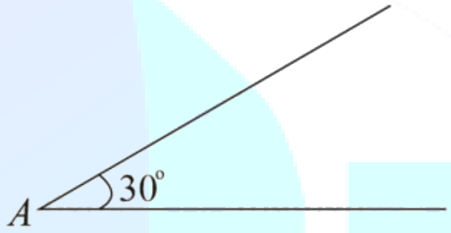
Q1. The velocity of a particle is $v = (v_0 + gt + Ft^2)\text{ms}^{-1}$. Its position is $x = 0$ at $t = 0$; then its displacement after time $(t = 1\text{ s})$ is :
(1) $v_0 + g + F$
(2) $v_0 + \frac{g}{2} + \frac{F}{3}$
(3) $v_0 + \frac{g}{2} + F$
(4) $v_0 + 2\text{ g} + 3\text{ F}$

Q2. Two identical blocks A and B each of mass m resting on the smooth horizontal floor are connected by a light spring of natural length L and spring constant K. A third block C of mass m moving with a speed v along the line joining A and B collides with A.The maximum compression in the spring is

(1) $v\sqrt{\frac{m}{2K}}$
(2) $\sqrt{\frac{mv}{2K}}$
(3) $\sqrt{\frac{mv}{K}}$
(4) $\sqrt{\frac{m}{2K}}$

Q3. A rubber ball is released from a height of 5 m above the floor. It bounces back repeatedly, always rising to $\frac{81}{100}$ of the height through which it falls. Find the average speed of the ball. (Take $g = 10\text{ m s}^{-2}$)
(1) 3.0 m s^{-1}
(2) 3.5 m s^{-1}
(3) 2.0 m s^{-1}
(4) 2.50 m s^{-1}

Q4. A sphere of mass 2 kg and radius 0.5 m is rolling with an initial speed of 1 m s^{-1} goes up an inclined plane which makes an angle of 30° with the horizontal plane, without slipping. How low will the sphere take to return to the starting point A ?

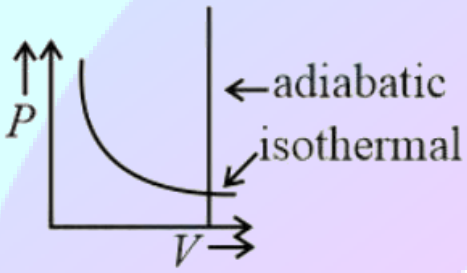


(1) 0.60 s
(2) 0.52 s
(3) 0.56 s
(4) 0.80 s

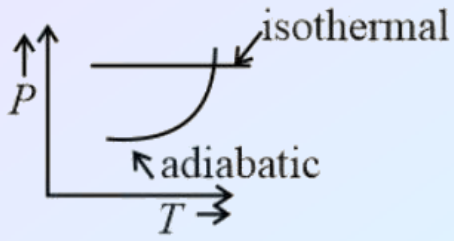
Q5. A geostationary satellite is orbiting around an arbitrary planet P at a height of $11R$ above the surface of P, R being the radius of P. The time period of another satellite in hours at a height of $2R$ from the surface of P is
has the time period of 24 hours.
(1) $6\sqrt{2}$
(2) $\frac{6}{\sqrt{2}}$
(3) 3
(4) 5

Q6. An object is located at 2 km beneath the surface of the water. If the fractional compression $\frac{\Delta V}{V}$ is 1.36%, the ratio of hydraulic stress to the corresponding hydraulic strain will be [Given: density of water is 1000 kg m^{-3} and $g = 9.8\text{ m s}^{-2}$.
(1) $1.96 \times 10^7\text{ N m}^{-2}$
(2) $1.44 \times 10^7\text{ N m}^{-2}$
(3) $2.26 \times 10^9\text{ N m}^{-2}$
(4) $1.44 \times 10^9\text{ N m}^{-2}$

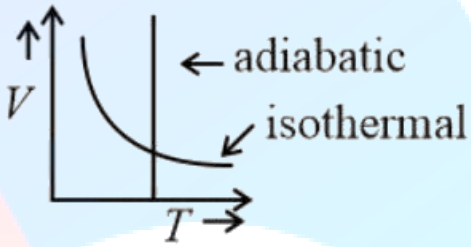
Q7. Which one is the correct option for the two different thermodynamic processes ?
(a)



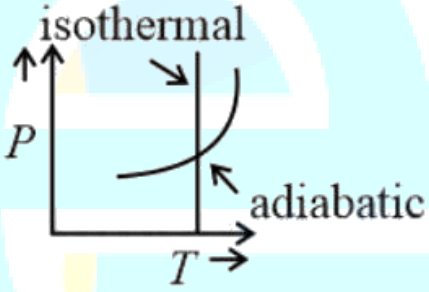
(b)



(c)



(d)



(1) (c) and (a)
(2) (c) and (d)
(3) (a) only
(4) (b) and (c)

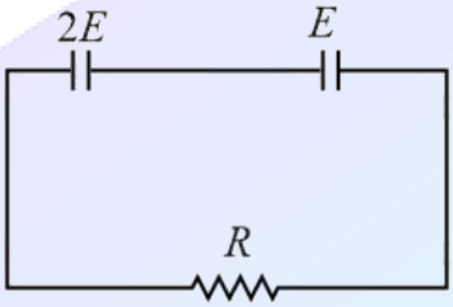
Q8. If one mole of the polyatomic gas is having two vibrational modes and β is the ratio of molar specific heats for polyatomic gas $\left(\beta = \frac{C_P}{C_v}\right)$ then the value of β is :
(1) 1.02
(2) 1.2
(3) 1.25
(4) 1.35

Q9. A block of mass 1 kg attached to a spring is made to oscillate with an initial amplitude of 12 cm . After 2 minutes the amplitude decreases to 6 cm . Determine the value of the damping constant for this motion. (take $\ln 2 = 0.693$)
(1) 1.16×10^{-2} kg s^{-1}
(2) 3.3×10^{2} kg s^{-1}
(3) 1.16×10^{2} kg s^{-1}
(4) 5.7×10^{-3} kg s^{-1}

Q10. Two particles A and B of equal masses are suspended from two massless springs of spring constants K_1 and K_2 respectively.If the maximum velocities during oscillations are equal, the ratio of the amplitude of A and B is
(1) $\frac{K_2}{K_1}$
(2) $\frac{K_1}{K_2}$
(3) $\sqrt{\frac{K_1}{K_2}}$
(4) $\sqrt{\frac{K_2}{K_1}}$

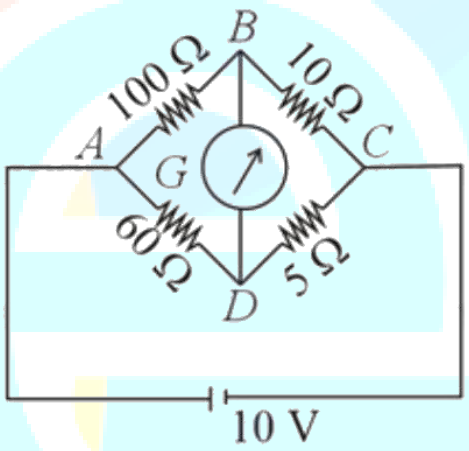
Q11. A sound wave of frequency 245 Hz travels with the speed of 300 m s^{-1} along the positive x -axis. Each point of the wave moves to and fro through a total distance of 6 cm . What will be the mathematical expression of this travelling wave?
(1) $Y(x,t) = 0.03[\sin 5.1x - (0.2 \times 10^3)t]$
(2) $Y(x,t) = 0.06[\sin 5.1x - (1.5 \times 10^3)t]$
(3) $Y(x,t) = 0.06[\sin 0.8x - (0.5 \times 10^3)t]$
(4) $Y(x,t) = 0.03[\sin 5.1x - (1.5 \times 10^3)t]$

Q12. Two cells of emf $2E$ and E with internal resistance r_1 and r_2 respectively are connected in series to an external resistor R (see figure). The value of R, at which the potential difference across the terminals of the first cell becomes zero is



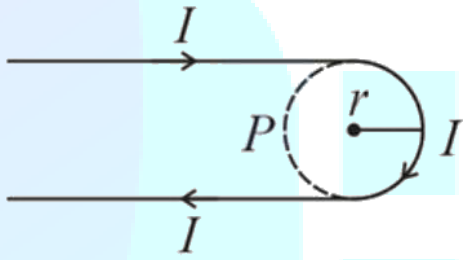
(1) $r_1 + r_2$
(2) $\frac{r_1}{2} - r_2$
(3) $\frac{r_1}{2} + r_2$
(4) $r_1 - r_2$

Q13. The four arms of a Wheatstone bridge have resistances as shown in the figure. A galvanometer of 15Ω resistance is connected across BD . Calculate the current through the galvanometer when a potential difference of 10 V is maintained across AC.



(1) 2.44μ A
(2) 2.44 mA
(3) 4.87 mA
(4) 4.87μ A

Q14. A hairpin like shape as shown in figure is made by bending a long current carrying wire. What is the magnitude of a magnetic field at point *P* which lies on the centre of the semicircle ?



(1) $\frac{\mu_0 I}{4\pi r}(2-\pi)$
(2) $\frac{\mu_0 I}{4\pi r}(2+\pi)$
(3) $\frac{\mu_0 I}{2\pi r}(2+\pi)$
(4) $\frac{\mu_0 I}{2\pi r}(2-\pi)$

Q15. Match List-I with List-II

List-i

Phase difference between current and voltage in a purely a resistive AC circuit

Phase difference between current and voltage in a pure inductive AC circuit Phase difference between current and
c voltage in a pure capacitive AC circuit $_d$ Phase difference between current and voltage in an LCR series circuit

List-II

$\frac{\pi}{2}$; current
i leads
voltage
ii zero
iii $\frac{\pi}{2}$; current lags
voltage
iv $\tan^{-1}\left(\frac{X_C - X_L}{R}\right)$

Choose the most appropriate answer from the options given below :
(1) (a) - (i), (b) - (iii), (c) - (iv), (d) - (ii)
(2) (a) - (ii), (b) - (iv), (c) - (iii), (d) - (i)

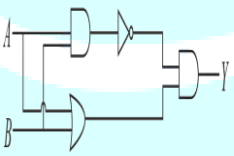
(3) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)
(4) (a)-(ii), (b) - (iii), (c) - (i), (d) - (iv)

Q16. What happens to the inductive reactance and the current in a purely inductive circuit if the frequency is halved ?
(1) Both, inductive reactance and current will be halved.
(2) Inductive reactance will be halved and current will be doubled..
(3) Inductive reactance will be doubled and current will be halved.
(4) Both, inducting reactance and current will be doubled

Q17. Two identical photocathodes receive the light of frequencies f_1 and f_2 respectively. If the velocities of the photo-electrons coming out are v_1 and v_2 respectively, then
(1) $v_1^2 - v_2^2 = \frac{2h}{m}[f_1 - f_2]$
(2) $v_1^2 + v_2^2 = \frac{2h}{m}[f_1 + f_2]$
(3) $v_1 + v_2 = \left[\frac{2h}{m}(f_1 + f_2)\right]^{\frac{1}{2}}$
(4) $v_1 - v_2 = \left[\frac{2h}{m}(f_1 - f_2)\right]^{\frac{1}{2}}$

Q18. The atomic hydrogen emits a line spectrum consisting of various series. Which series of hydrogen atomic spectra is lying in the visible region?
(1) Brackett series
(2) Paschen series
(3) Lyman series
(4) Balmer series

Q19. Which one of the following will be the output of the given circuit?

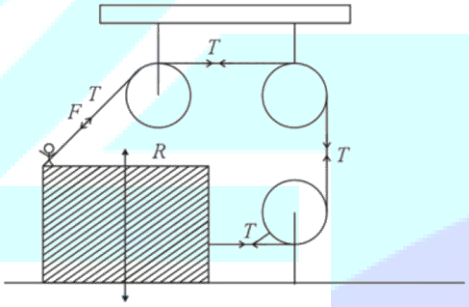


(1) NOR Gate
(2) NAND Gate
(3) AND Gate
(4) XOR Gate

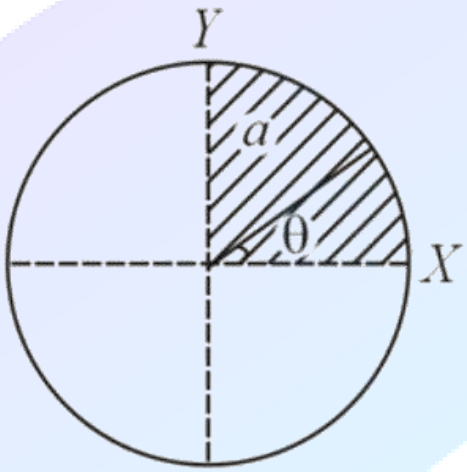
Q20. A carrier signal $C(t) = 25\sin(2.512 \times 10^{10}t)$ is amplitude modulated by a message signal $m(t) = 5\sin(1.57 \times 10^{8}t)$ and transmitted through an antenna. What will be the bandwidth of the modulated signal ?
(1) 8 GHz
(2) 2.01 GHz
(3) 1987.5 MHz
(4) 50 MHz

Q21. A body of mass 1 kg rests on a horizontal floor with which it has a coefficient of static friction $\frac{1}{\sqrt{3}}$. It is desired to make the body move by applying the minimum possible force F N. The value of F will be . (Round off to the Nearest Integer) [Take $g = 10$ m s^{-2}]

Q22. A boy of mass 4 kg is standing on a piece of wood having mass 5 kg . If the coefficient of friction between the wood and the floor is 0.5 , the maximum force that the boy can exert on the rope so that the piece of wood does not move from its place is N. (Round off to the Nearest Integer)
[Take $g = 10$ m s^{-2}]



Q23. The disc of mass M with uniform surface mass density σ is shown in the figure. The center of mass of the quarter disc (the shaded area) is at the position $\left(\frac{xa}{3\pi}, \frac{xa}{3\pi}\right)$ where x is . (Round off to the Nearest Integer) [a is an area as shown in the figure]

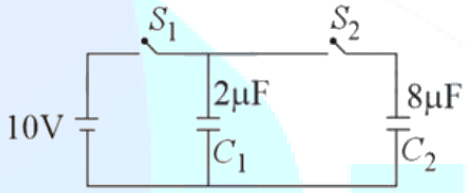


Q24. Suppose you have taken a dilute solution of oleic acid in such a way that its concentration becomes 0.01 cm^3 of oleic acid per cm^3 of the solution. Then you make a thin film of this solution (monomolecular thickness) of area 4 cm^2 by considering 100 spherical drops of radius $\left(\frac{3}{40\pi}\right)^{\frac{1}{3}} \times 10^{-3}$ cm. Then the thickness of oleic acid layer will be $x \times 10^{-14}$ m. Where x is .

Q25. The electric field intensity is produced by the radiation coming from a 100 W bulb at a distance of 3 m is E. The electric field intensity produced by the radiation coming from 60 W at the same distance is $\sqrt{\frac{x}{5}}E$. Where the value of $x =$.

Q26. The electric field in a region is given by $\vec{E} = \frac{2}{5}E_0\hat{i} + \frac{3}{5}E_{0j}\hat{j}$ with $E_0 = 4.0 \times 10^3$ NC^{-1}. The flux of this field through a rectangular surface, area 0.4 m^2 parallel to the $Y-Z$ plane is Nm^2C^{-1}.

Q27.A 2μ F capacitor C_1 is first charged to a potential difference of 10 V using a battery. Then the battery is removed and the capacitor is connected to an uncharged capacitor C_2 of 8μ F. The charge in C_2 on equilibrium condition is μC. (Round off to the Nearest Integer)



Q28. Seawater at a frequency $f = 9 \times 10^2$ Hz, has permittivity $\varepsilon = 80\varepsilon_0$ and resistivity $\rho = 0.25\Omega$ m. Imagine a parallel plate capacitor is immersed in seawater and is driven by an alternating voltage source $V(t) = V_0\sin(2\pi ft)$. Then the conduction current density becomes 10^x times the displacement current density after time $t = \frac{1}{800}$ s. The value of x is
(Given : $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ N m^2C^{-2})

Q29. The image of an object placed in air formed by a convex refracting surface is at a distance of 10 m behind the surface. The image is real and is at $\frac{2^{rd}}{3}$ of the distance of the object from the surface. The wavelength of light inside the surface is $\frac{2}{3}$ times the wavelength in air. The radius of the curved surface is $\frac{x}{13}$ m, the value of x is .

Q30. A particle of mass m moves in a circular orbit in a central potential field $U(r) = U_0r^4$. If Bohr's quantization conditions are applied, radii of possible orbitals r_n vary with $n^{\frac{1}{\alpha}}$, where α is .

Q31. Amongst the following, the linear species is:
(1) NO_2
(2) Cl_2O
(3) O_3
(4) N_3^-

Q32. During which of the following processes, does entropy decrease?
(A) Freezing of water to ice at $0°C$
(B) Freezing of water to ice at $-10°C$
(C) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
(D) Adsorption of $CO(g)$ and lead surface
(E) Dissolution of NaCl in water
(1) (A), (B),(C) and (D) only
(2) (B) and (C) only
(3) (A) and (E) only
(4) (A), (C) and (E) only

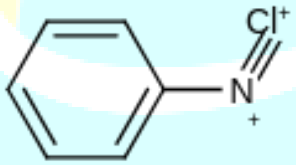
Q33. The functional groups that are responsible for the ion-exchange property of cation and anion exchange resins, respectively, are :
(1) $-SO_3H$ and $-NH_2$
(2) $-SO_3H$ and -COOH
(3) $-NH_2$ and -COOH
(4) $-NH_2$ and $-SO_3H$

Q34. The set of elements that differ in mutual relationship from those of the other sets is:
(1) $Li - Mg$
(2) $B - Si$
(3) $Be - Al$
(4) $Li - Na$

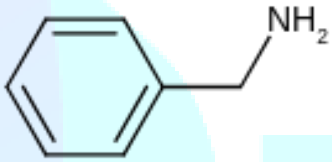
Q35. One of the by-products formed during the recovery of NH_3 from Solvay process is:
(1) $Ca(OH)_2$
(2) $NaHCO_3$
(3) $CaCl_2$
(4) NH_4Cl

Q36. The correct pair(s) of the ambident nucleophiles is (are):
(A) AgCN / KCN
(B) RCOOAg / RCOOK
(C) $AgNO_2/KNO_2$
(D) AgI/KI
(1) (B) and (C) only
(2) (A) only
(3) (A) and (C) only
(4) (B) only

Q37. Nitrogen can be estimated by Kjeldahl's method for which of the following compound?
(1)

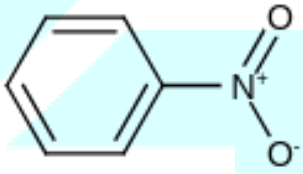


(2)



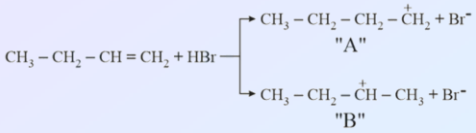
(3)

(4)



Q38. Given below are two statements:
Statement-I : 2 -methylbutane on oxidation with $KMnO_4$ gives 2 -methylbutan-2-ol.
Statement-II : n -alkanes can be easily oxidised to corresponding alcohol with $KMnO_4$.
Choose the correct option :
(1) Both statement I and statement II are correct
(2) Both statement I and statement II are incorrect
(3) Statement I is correct but Statement II is incorrect
(4) Statement I is incorrect but Statement II is correct

Q39. Choose the correct statement regarding the formation of carbocations A and B given :-



(1) Carbocation B is more stable and formed relatively at faster rate
(2) Carbocation A is more stable and formed relatively at slow rate
(3) Carbocation B is more stable and formed relatively at slow rate
(4) Carbocation A is more stable and formed relatively at faster rate

Q40. Which of the following statement(s) is (are) incorrect reason for eutrophication?
(A) excess usage of fertilisers
(B) excess usage of detergents
(C) dense plant population in water bodies
(D) lack of nutrients in water bodies that prevent plant growth

Choose the most appropriate answer from the options given below :
(1) (A) only
(2) (C) only
(3) (B) and (D) only
(4) (D) only

Q41. For the coagulation of a negative sol, the species below, that has the highest flocculating power is:
(1) SO_4^{2-}
(2) Ba^{2+}
(3) Na^{+}
(4) PO_4^{3-}

Q42. Match List-I and List-II :

List-I

a Haematite mathon $Al_2O_3 \cdot xH_2O$
b Bauxite
c Magnetite
d Malachite

List-II

Choose the correct answer from the options given below :
(1) (a)-(ii), (b)-(iii),(c)-(i), (d)-(iv)
(2) (a)-(iv), (b) - (i), (c) - (ii), (d) - (iii)
(3) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)
(4) (a) - (ii), (b) - (i), (c) - (iv),
(d) - (iii)

Q43. The set that represents the pair of neutral oxides of nitrogen is:
(1) NO and N_2O
(2) N_2O and N_2O_3
(3) N_2O and NO_2
(4) NO and NO_2

Q44. The common positive oxidation states for an element with atomic number 24 , are:
(1) +2 to +6
(2) +1 and +3 to +6
(3) +1 and +3
(4) +1 to +6

Q45. Match List-I with List-II :

List-I

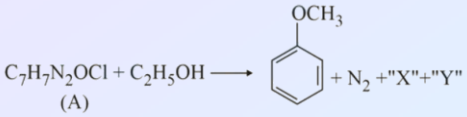
a $[Co(NH_3)_6][Cr(CN)_6]$
b $[Co(NH_3)_3(NO_2)_3]$
c $[Cr(H_2O)_6]Cl_3$
d cis $-[CrCl_2(ox)_2]^{3-}$

List-II

i Linkage isomerism
ii Solvate isomerism
iii Co-ordination isomerism
iv Optical isomerism

Choose the correct answer from the options given below:
(1) (a) - (iii), (b) - (i), (c) - (ii), (d) - (iv)
(2) (a)-(iv), (b) - (ii), (c) - (iii), (d) - (i)
(3) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)
(4) (a) $-$ (i), (b) $-$ (ii), (c) $-$ (iii), (d) $-$ (iv)

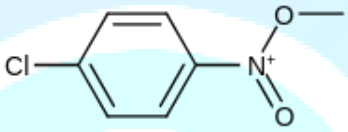
Q46.

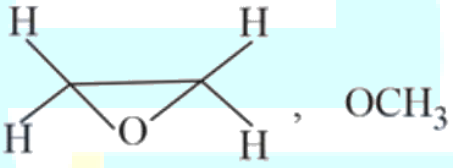


In the above reaction, the structural formula of (A), "X" and "Y" respectively are :

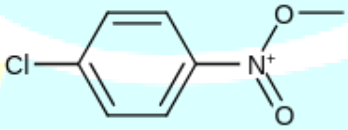
(1)

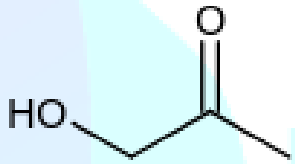
(2)



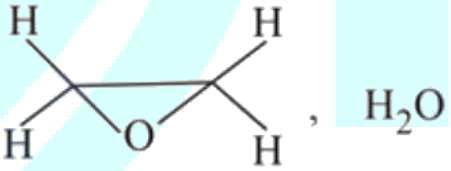


(3)





(4)



Q47. Primary, secondary and tertiary amines can be separated using:

(1) Para-Toluene sulphonyl chloride
(2) Chloroform and KOH
(3) Benzene sulphonic acid
(4) Acetyl amide

Q48. Match List-I with List-II :

List-I Chemical Compound

a Sucralose
b Glyceryl ester of stearic acid
c Sodium benzoate
d Bithional

Choose the correct match :

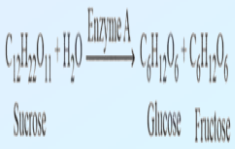
List-II Used as

i Synthetic detergent
ii Artificial sweetener

iii Antiseptic
iv Food preservative
(1) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)
(2) (a) - (ii), (b) - (i), (c) - (iv),
(d) - (iii)
(3) (a)-(iii), (b)-(ii), (c) - (iv), (d) - (i)
(4) (a) - (i), (b) - (ii), (c) - (iv), (d) - (iii)

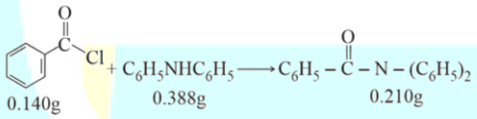
Q49. Fructose is an example of :-
(1) Pyranose
(2) Ketohexose
(3) Aldohexose
(4) Heptose

Q50.



$C_6H_{12}O_6 \xrightarrow{\text{Enzyme B}} 2C_2H_5OH + 2CO_2$
Glucose
In the above reactions, the enzyme A and enzyme B respectively are :-
(1) Amylase and Invertase
(2) Invertase and Amylase
(3) Invertase and Zymase
(4) Zymase and Invertase

Q51.



Consider the above reaction. The percentage yield of amide product is (Round off to the Nearest Integer). (Given : Atomic mass : C : 12.0u, H: 1.0uN: 14.0u, O: 16.0u, Cl: 35.5u)

Q52. The number of chlorine atoms in 20 mL of chlorine gas at STP is 10^{21}. (Round off to the Nearest Integer). [Assume chlorine is an ideal gas at STP R = 0.083 L bar mol^{-1} K^{-1}, $N_A = 6.023 \times 10^{23}$]

Q53. Consider the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ The temperature at which $K_C = 20.4$ and $K_P = 600.1$, is
K. (Round off to the Nearest Integer). [Assume all gases are ideal and R = 0.0831 L bar K^{-1} mol^{-1}]

Q54. The total number of $C-C$ sigma bond/s in mesityl oxide $(C_6H_{10}O)$ is (Round off to the Nearest Integer).
Q55. KBr is doped with 10^{-5} mole percent of $SrBr_2$ The number of cationic vacancies in 1 g of KBr crystal is 10^{14} . (Round off to the Nearest Integer). [Atomic Mass : K = 39.1u, Br = 79.9u, $N_A = 6.023 \times 10^{23}$]

Q56. A 1 molal $K_4Fe(CN)_6$ solution has a degree of dissociation of 0.4 . Its boiling point is equal to that of another solution which contains 18.1 weight percent of a non electrolytic solute A . The molar mass of A is u. (Round off to the Nearest Integer). [Density of water = 1.0 g cm^{-3}]

Q57. A KCl solution of conductivity 0.14 S m^{-1} shows a resistance of 4.19Ω in a conductivity cell. If the same cell is filled with an HCl solution, the resistance drops to 1.03Ω. The conductivity of the HCl solution is × 10^{-2} S m^{-1}. (Round off to the Nearest Integer).

Q58. The reaction $2A + B_2 \rightarrow 2AB$ is an elementary reaction.
For a certain quantity of reactants, if the volume of the reaction vessel is reduced by a factor of 3 , the rate of the reaction increases by a factor of . (Round off to the Nearest Integer).

Q59. In the ground state of atomic Fe(Z = 26), the spin-only magnetic moment is × 10^{-1}BM. (Round off to the Nearest Integer).
[Given : $\sqrt{3} = 1.73, \sqrt{2} = 1.41$]
Q60. On complete reaction of $FeCl_3$ with oxalic acid in aqueous solution containing KOH , resulted in the formation of product A . The secondary valency of Fe in the product A is . (Round off to the Nearest Integer).
Q61. Let S_1, S_2 and S_3 be three sets defined as
$S_1 = \{z \in \mathbb{C}: |z-1| \leq \sqrt{2}\}$,
$S_2 = \{z \in \mathbb{C}: \text{Re}((1-i)z) \geq 1\}$ and
$S_3 = \{z \in \mathbb{C}: \text{Im}(z) \leq 1\}$.

Then, the set $S_1 \cap S_2 \cap S_3$
(1) is a singleton
(2) has exactly two elements
(3) has infinitely many elements
(4) has exactly three elements

Q62. If the sides AB, BC and CA of a triangle ABC have 3,5 and 6 interior points respectively, then the total number of triangles that can be constructed using these points as vertices, is equal to:
(1) 364
(2) 240
(3) 333
(4) 360

Q63. The value of $\sum_{r=0}^{6}({}^6C_r \cdot {}^6C_{6-r})$ is equal to :
(1) 1124
(2) 1324
(3) 1024
(4) 924

Q64. The number of solutions of the equation $x + 2\tan x = \frac{\pi}{2}$ in the interval $[0,2\pi]$ is
(1) 3
(2) 4
(3) 2
(4) 5

Q65. Two tangents are drawn from a point P to the circle $x^2 + y^2 - 2x - 4y + 4 = 0$, such that the angle between these tangents is $\tan^{-1}\left(\frac{12}{5}\right)$, where $\tan^{-1}\left(\frac{12}{5}\right) \in (0, \pi)$. If the centre of the circle is denoted by C and these tangents touch the circle at points A and B, then the ratio of the areas of $\triangle PAB$ and $\triangle CAB$ is :
(1) 11: 4
(2) 9: 4
(3) 3: 1
(4) 2: 1

Q66. Let the tangent to the circle $x^2 + y^2 = 25$ at the point $R(3,4)$ meet x-axis and y-axis at point P and Q, respectively. If r is the radius of the circle passing through the origin O and having centre at the incentre of the triangle OPQ, then r^2 is equal to
(1) $\frac{529}{64}$
(2) $\frac{125}{72}$
(3) $\frac{625}{72}$
(4) $\frac{585}{66}$

Q67. Let L be a tangent line to the parabola $y^2 = 4x - 20$ at (6,2). If L is also a tangent to the ellipse $\frac{x^2}{2} + \frac{y^2}{b} = 1$, then the value of b is equal to :
(1) 11
(2) 14
(3) 16
(4) 20

Q68. The value of $\lim_{n\to\infty} \frac{[r]+[2r]+\cdots+[nr]}{n^2}$, where r is non-zero real number and $[r]$ denotes the greatest integer less than or equal to r, is equal to :
(1) $\frac{r}{2}$
(2) r
(3) $2r$
(4) 0

Q69. The value of the limit $\lim_{\theta\to 0} \frac{\tan(\pi\cos^2\theta)}{\sin(2\pi\sin^2\theta)}$ is equal to :
(1) $-\frac{1}{2}$
(2) $-\frac{1}{4}$
(3) 0
(4) $\frac{1}{4}$

Q70. If the Boolean expression $(p \wedge q) \circledast (p \otimes q)$ is a tautology, then $\circledast$ and $\otimes$ are respectively given by
(1) $\rightarrow, \rightarrow$
(2) $\wedge, \vee$
(3) $\vee, \rightarrow$
(4) $\wedge, \rightarrow$

Q71.If x, y, z are in arithmetic progression with common difference $d, x \neq 3d$, and the determinant of the matrix $\begin{bmatrix} 3 & 4\sqrt{2} & x \\ 4 & 5\sqrt{2} & y \\ 5 & k & z \end{bmatrix}$ is zero, then the value of k^2 is
(1) 72
(2) 12

(3) 36
(4) 6

Q72. The number of solutions of the equation $\sin^{-1}\left[x^2+\frac{1}{3}\right]+\cos^{-1}\left[x^2-\frac{2}{3}\right]=x^2$ for $x\in[-1,1]$, and $[x]$ denotes the greatest integer less than or equal to x, is :
(1) 2
(2) 0
(3) 4
(4) Infinite

Q73. Consider the function $f:R\to R$ defined by $f(x)=\begin{cases}\left(2-\sin\left(\frac{1}{x}\right)\right)|x|, & x\neq 0\\ 0, & x=0\end{cases}$. Then f is:
(1) monotonic on $(-\infty,0)\cup(0,\infty)$
(2) not monotonic on $(-\infty,0)$ and $(0,\infty)$
(3) monotonic on $(0,\infty)$ only
(4) monotonic on $(-\infty,0)$ only

Q74. Let $f:R\to R$ be defined as $f(x)=e^{-x}\sin x$. If $F:[0,1]\to R$ is a differentiable function such that $F(x)=\int_0^x f(t)dt$, then the value of $\int_0^1(F'(x)+f(x))e^x dx$ lies in the interval
(1) $\left[\frac{327}{360},\frac{329}{360}\right]$
(2) $\left[\frac{330}{360},\frac{331}{360}\right]$
(3) $\left[\frac{331}{360},\frac{334}{360}\right]$
(4) $\left[\frac{335}{360},\frac{336}{360}\right]$

Q75. If the integral $\int_0^{10}\frac{[\sin 2\pi x]}{e^{x-[x]}}dx=\alpha e^{-1}+\beta e^{-\frac{1}{2}}+\gamma$, where α,β,γ are integers and $[x]$ denotes the greatest integer less than or equal to x, then the value of $\alpha+\beta+\gamma$ is equal to:
(1) 0
(2) 20
(3) 25
(4) 10

Q76. Let $y=y(x)$ be the solution of the differential equation $\cos x(3\sin x+\cos x+3)dy=(1+y\sin x(3\sin x+\cos x+3))dx, 0\le x\le\frac{\pi}{2}, y(0)=0$. Then, $y\left(\frac{\pi}{3}\right)$ is equal to:
(1) $2\log_e\left(\frac{2\sqrt{3}+9}{6}\right)$
(2) $2\log_e\left(\frac{2\sqrt{3}+10}{11}\right)$
(3) $2\log_e\left(\frac{\sqrt{3}+7}{2}\right)$
(4) $2\log_e\left(\frac{3\sqrt{3}-8}{4}\right)$

Q77. If the curve $y=y(x)$ is the solution of the differential equation $2\left(x^2+x^{5/4}\right)dy-y\left(x+x^{1/4}\right)dx=2x^{9/4}dx, x>0$ which passes through the point $\left(1,1-\frac{4}{3}\log_e 2\right)$, then the value of $y(16)$ is equal to
(1) $4\left(\frac{31}{3}+\frac{8}{3}\log_e 3\right)$
(2) $\left(\frac{31}{3}+\frac{8}{3}\log_e 3\right)$
(3) $4\left(\frac{31}{3}-\frac{8}{3}\log_e 3\right)$
(4) $\left(\frac{31}{3}-\frac{8}{3}\log_e 3\right)$

Q78. Let O be the origin. Let $\overrightarrow{OP}=x\hat{i}+y\hat{j}-\hat{k}$ and $\overrightarrow{OQ}=-\hat{i}+2\hat{j}+3x\hat{k}, x,y\in R, x>0$, be such that $|\overrightarrow{PQ}|=\sqrt{20}$ and the vector $\overrightarrow{OP}$ is perpendicular to $\overrightarrow{OQ}$. If $\overrightarrow{OR}=3\hat{i}+z\hat{j}-7\hat{k}, z\in R$, is coplanar with $\overrightarrow{OP}$ and $\overrightarrow{OQ}$, then the value of $x^2+y^2+z^2$ is equal to
(1) 7
(2) 9
(3) 2
(4) 1

Q79. If the equation of plane passing through the mirror image of a point $(2,3,1)$ with respect to line $\frac{x+1}{2}=\frac{y-3}{1}=\frac{z+2}{-1}$ and containing the line $\frac{x-2}{3}=\frac{1-y}{2}=\frac{z+1}{1}$ is $\alpha x+\beta y+\gamma z=24$ then $\alpha+\beta+\gamma$ is equal to:
(1) 20
(2) 19
(3) 18
(4) 21

Q80. Let a computer program generate only the digits 0 and 1 to form a string of binary numbers with probability of occurrence of 0 at even places be $\frac{1}{2}$ and probability of occurrence of 0 at the odd place be $\frac{1}{3}$. Then the probability that 10 is followed by 01 is equal to :
(1) $\frac{1}{18}$
(2) $\frac{1}{3}$

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

Q81.If $1, \log_{10}(4^x - 2)$ and $\log_{10}\left(4^x + \frac{18}{5}\right)$ are in arithmetic progression for a real number x then the value of the determinant
$\begin{vmatrix} 2\left(x-\frac{1}{2}\right) & x-1 & x^2 \\ 1 & 0 & x \\ x & 1 & 0 \end{vmatrix}$ is equal to:

Q82. Let the coefficients of third, fourth and fifth terms in the expansion of $\left(x + \frac{a}{x^2}\right)^n, x \neq 0$, be in the ratio $12:8:3$. Then the term independent of x in the expansion, is equal to .

Q83. Let $\tan\alpha, \tan\beta$ and $\tan\gamma; \alpha, \beta, \gamma \neq \frac{(2n-1)\pi}{2}, n \in N$ be the slopes of the three line segments OA, OB and OC, respectively, where O is origin. If circumcentre of $\triangle ABC$ coincides with origin and its orthocentre lies on y-axis, then the value of $\left(\frac{\cos 3\alpha + \cos 3\beta + \cos 3\gamma}{\cos\alpha \cdot \cos\beta \cdot \cos\gamma}\right)^2$ is equal to :

Q84. Consider a set of $3n$ numbers having variance 4 . In this set, the mean of first $2n$ numbers is 6 and the mean of the remaining n numbers is 3 . A new set is constructed by adding 1 into each of the first $2n$ numbers, and subtracting 1 from each of the remaining n numbers. If the variance of the new set is k, then $9k$ is equal to
.

Q85. Let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ and $B = \begin{bmatrix} \alpha \\ \beta \end{bmatrix} \neq \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ such that $AB = B$ and $a + d = 2021$, then the value of $ad - bc$ is equal to .

Q86. Let $f: [-1,1] \to R$ be defined as $f(x) = ax^2 + bx + c$ for all $x \in [-1,1]$, where $a, b, c \in R$ such that $f(-1) = 2, f'(-1) = 1$ and for $x \in (-1,1)$ the maximum value of $f''(x)$ is $\frac{1}{2}$. If $f(x) \leq \alpha, x \in [-1,1]$, then the least value of α is equal to

Q87. Let $I_n = \int_1^e x^{19}(\log|x|)^n dx$, where $n \in N$. If (20) $I_{10} = \alpha I_9 + \beta I_8$, for natural numbers α and β, then $\alpha - \beta$ equal to .

Q88. Let $f: [-3,1] \to R$ be given as $f(x) = \begin{cases} \min\{(x+6), x^2\}, & -3 \leq x \leq 0 \\ \max\{\sqrt{x}, x^2\}, & 0 \leq x \leq 1 \end{cases}$.If the area bounded by $y = f(x)$ and x-axis is A sq units, then the value of $6A$ is equal to

Q89. Let $\vec{x}$ be a vector in the plane containing vectors $\vec{a} = 2\hat{\imath} - \hat{\jmath} + \hat{k}$ and $\vec{b} = \hat{\imath} + 2\hat{\jmath} - \hat{k}$. If the vector $\vec{x}$ is perpendicular to $(3\hat{\imath} + 2\hat{\jmath} - \hat{k})$ and its projection on $\vec{a}$ is $\frac{17\sqrt{6}}{2}$, then the value of $|\vec{x}|^2$ is equal to .

Q90. Let P be an arbitrary point having sum of the squares of the distance from the planes $x + y + z = 0, lx - nz = 0$ and $x - 2y + z = 0$ equal to 9 units. If the locus of the point P is $x^2 + y^2 + z^2 = 9$, then the value of $l - n$ is equal to

ANSWER KEYS

1. (2) atho	2. (1)	ma. (4)	4. (3)	5. (3) athot	6. (4)	ma. (2)	8. (2)
9. (1)	10. (4)	11. (4)	12. (2)	13. (3)	14. (2)	15. (4)	16. (2)
17. (1)	18. (4)	mat 19. (4)	20. (4)	21. (5)	22. (30)	ma3. (4)	24. (25)
25. (3)	26. (640)	27. (16)	28. (6)	29. (30)	30. (3)	31. (4)	32. (1)
33. (1)	34. (4)	35. (3)	36. (3)	37. (2)	38. (3)	39. (1)	40. (4)
41. (2)	42. (4)	43. (1)	44. (1)	45. (1)	46. (1)	47. (1)	48. (2)
49. (2)	50. (3)	51. (77)	52. (1)	53. (354)	54. (5)	55. (5)	56. (85)
57. (57)	58. (27)	59. (49)	60. (6)	61. (3)	62. (3)	mo63. (4)	64. (1) anco
65. (2)	66. (3)	67. (2)	68. (1)	69. (1)	70. (1)	71. (1)	72. (2)
73. (2)	74. (2)	75. (1)	76. (2)	77. (3)	78. (2)	79. (2)	80. (4)
81. (2)	82. (4)	83. (144)	84. (68)	85. (2020)	86. (5)	87. (1)	88. (41)
89. (486)	90. (0)						