Q1. The dimensional formula of latent heat is :

(1) $\left[\mathrm{ML}^2\ \mathrm{T}^{-2}\right]$ (2) $\left[\mathrm{M}^0\ \mathrm{L}^2\ \mathrm{T}^{-2}\right]$

(3) $\left[\mathrm{MLT}^{-2}\right]$ (4) $\left[\mathrm{M}^{\circ}\mathrm{LT}^{-2}\right]$

Q2. A particle moving in a straight line covers half the distance with speed $6\ \mathrm{m/s}$. The other half is covered in two equal time intervals with speeds $9\ \mathrm{m/s}$ and $15\ \mathrm{m/s}$ respectively. The average speed of the particle during the motion is :

(1) $10\ \mathrm{m/s}$ (2) $8\ \mathrm{m/s}$

(3) $9.2\ \mathrm{m/s}$ (4) $8.8\ \mathrm{m/s}$

Q3. A light unstretchable string passing over a smooth light pulley connects two blocks of masses m_1 and m_2. If the acceleration of the system is $\frac{g}{8}$, then the ratio of the masses $\frac{m_2}{m_1}$ is :

(1) $8:1$ (2) $5:3$

(3) $4:3$ (4) $9:7$

Q4. A particle of mass m moves on a straight line with its velocity increasing with distance according to the equation $v=\alpha\sqrt{x}$, where α is a constant. The total work done by all the forces applied on the particle during its displacement from $x=0$ to $x=\mathrm{d}$, will be :

(1) $\frac{\mathrm{m}}{2\alpha^2\ \mathrm{d}}$ (2) $\frac{\mathrm{md}}{2\alpha^2}$

(3) $2\ \mathrm{m}\alpha^2\ \mathrm{d}$ (4) $\frac{m\alpha^2\ \mathrm{d}}{2}$

Q5. A heavy iron bar, of weight W is having its one end on the ground and the other on the shoulder of a person. The bar makes an angle θ with the horizontal. The weight experienced by the person is :

(1) $\mathrm{W}\cos\theta$ (2) $\frac{W}{2}$

(3) W (4) $W\sin\theta$

Q6. An astronaut takes a ball of mass m from earth to space. He throws the ball into a circular orbit about earth at an altitude of $318.5\ \mathrm{km}$. From earth's surface to the orbit, the change in total mechanical energy of the ball is $x\frac{\mathrm{GM_em}}{21\mathrm{R_e}}$. The value of x is (take $\mathrm{R_e}=6370\ \mathrm{km}$) :

(1) 10 (2) 12

(3) 9 (4) 11

Q7. A sphere of relative density σ and diameter D has concentric cavity of diameter d. The ratio of $\frac{D}{d}$, if it just floats on water in a tank is :

(1) $\left(\frac{\sigma-2}{\sigma+2}\right)^{1/3}$ (2) $\left(\frac{\sigma}{\sigma-1}\right)^{1/3}$

(3) $\left(\frac{\sigma-1}{\sigma}\right)^{1/3}$ (4) $\left(\frac{\sigma+1}{\sigma-1}\right)^{1/3}$

Q8. A sample of 1 mole gas at temperature T is adiabatically expanded to double its volume. If adiabatic constant for the gas is $\gamma=\frac{3}{2}$, then the work done by the gas in the process is:

(1) $\frac{R}{T}[2-\sqrt{2}]$ (2) $\frac{T}{R}[2+\sqrt{2}]$

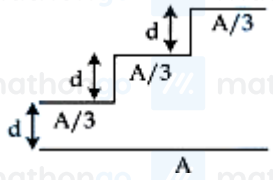
(3) $\mathrm{RT}\ [2-\sqrt{2}]$ (4) $\mathrm{RT}[2+\sqrt{2}]$

Q9. The volume of an ideal gas $(\gamma=1.5)$ is changed adiabatically from 5 litres to 4 litres. The ratio of initial pressure to final pressure is:

(1) $\frac{16}{25}$ (2) $\frac{4}{5}$
(3) $\frac{8}{5\sqrt{5}}$ (4) $\frac{2}{\sqrt{5}}$

Q10. A bulb and a capacitor are connected in series across an ac supply. A dielectric is then placed between the plates of the capacitor. The glow of the bulb:
(1) increases (2) decreases
(3) remains same (4) becomes zero

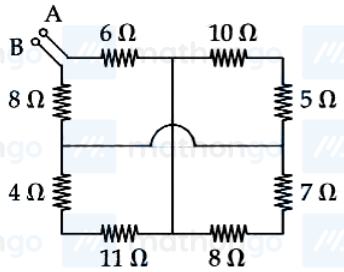
Q11. A capacitor is made of a flat plate of area A and a second plate having a stair-like structure as shown in figure. If the area of each stair is $\frac{A}{3}$ and the height is d, the capacitance of the arrangement is :



(1) $\frac{13\epsilon_o A}{17d}$ (2) $\frac{11\epsilon_o \mathrm{A}}{18\ \mathrm{d}}$
(3) $\frac{18\epsilon_o \mathrm{A}}{11\ \mathrm{d}}$ (4) $\frac{11\epsilon_o \mathrm{A}}{20\ \mathrm{d}}$

Q12. A galvanmeter has a coil of resistance 200Ω with a full scale deflection at $20\mu\mathrm{A}$. The value of resistance to be added to use it as an ammeter of range $(0-20)\mathrm{mA}$ is ;
(1) 0.40Ω (2) 0.20Ω
(3) 0.50Ω (4) 0.10Ω

Q13.



The equivalent resistance between A and B is :
(1) 18Ω (2) 19Ω
(3) 25Ω (4) 27Ω

Q14. Given below are two statements : Statement (I) : When currents vary with time, Newton's third law is valid only if momentum carried by the electromagnetic field is taken into account. Statement (II) : Ampere's circuital law does not depend on Biot-Savart's law. In the light of the above statements, choose the correct answer from the options given below :
(1) Both Statement I and Statement II are true (2) Statement I is true but Statement II is false
(3) Both Statement I and Statement II are false (4) Statement I is false but Statement II is true

Q15. A plane EM wave is propagating along x direction. It has a wavelength of 4 mm. If electric field is in y direction with the maximum magnitude of $60\mathrm{Vm}^{-1}$, the equation for magnetic field is :
(1) $\mathrm{B}_z = 2\times10^{-7}\sin\left[\frac{\pi}{2}\times10^3\left(x-3\times10^8\mathrm{t}\right)\right]\hat{\mathrm{k}}\mathrm{T}$ (2) $\mathrm{B}_z = 60\sin\left[\frac{\pi}{2}\left(x-3\times10^8\mathrm{t}\right)\right]\hat{\mathrm{k}}\mathrm{T}$
(3) $\mathrm{B}_x = 60\sin\left[\frac{\pi}{2}\left(x-3\times10^8\mathrm{t}\right)\right]\mathrm{i}\,\hat{T}$ (4) $\mathrm{B}_z = 2\times10^{-7}\sin\left[\frac{\pi}{2}\left(x-3\times10^8\mathrm{t}\right)\right]\hat{\mathrm{k}}\mathrm{T}$

Q16. Given below are two statements : Statement (I) : When an object is placed at the centre of curvature of a concave lens, image is formed at the centre of curvature of the lens on the other side. Statement (II) : Concave lens always forms a virtual and erect image. In the light of the above statements, choose the correct answer from the options 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

Q17. A proton, an electron and an alpha particle have the same energies. Their de-Broglie wavelengths will be compared as :

(1) $\lambda_\alpha < \lambda_\mathrm{p} < \lambda_\mathrm{e}$
(2) $\lambda_\mathrm{e} > \lambda_\alpha > \lambda_\mathrm{p}$
(3) $\lambda_\mathrm{p} > \lambda_\mathrm{e} > \lambda_\alpha$
(4) $\lambda_\mathrm{p} < \lambda_\mathrm{e} < \lambda_\alpha$

Q18. The energy equivalent of 1 g of substance is :

(1) $5.6 \times 10^{12}\mathrm{MeV}$
(2) $5.6 \times 10^{26}\mathrm{MeV}$
(3) $11.2 \times 10^{24}\mathrm{MeV}$
(4) $5.6\mathrm{eV}$

Q19. A light emitting diode (LED) is fabricated using GaAs semiconducting material whose band gap is 1.42eV. The wavelength of light emitted from the LED is :

(1) 1400 nm
(2) 650 nm
(3) 875 nm
(4) 1243 nm

Q20. One main scale division of a vernier caliper is equal to m units. If n^{th} division of main scale coincides with $(n+1)^{\mathrm{th}}$ division of vernier scale, the least count of the vernier caliper is :

(1) $\frac{n}{(n+1)}$
(2) $\frac{1}{(n+1)}$
(3) $\frac{m}{(n+1)}$
(4) $\frac{m}{n(n+1)}$

Q21. If $\vec{a}$ and $\vec{b}$ makes an angle $\cos^{-1}\left(\frac{5}{9}\right)$ with each other, then $|\vec{a}+\vec{b}| = \sqrt{2}|\vec{a}-\vec{b}|$ for $|\vec{a}| = n|\vec{b}|$ The integer value of n is ____

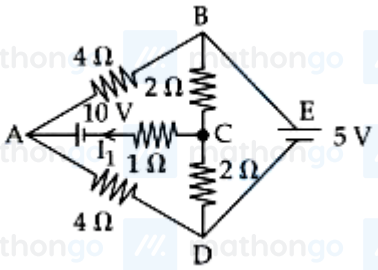
Q22. A string is wrapped around the rim of a wheel of moment of inertia $0.40\mathrm{kgm}^2$ and radius 10 cm. The wheel is free to rotate about its axis. Initially the wheel is at rest. The string is now pulled by a force of 40 N. The angular velocity of the wheel after 10 s is $x\mathrm{rad/s}$, where x is _____

Q23. Two persons pull a wire towards themselves. Each person exerts a force of 200 N on the wire. Young's modulus of the material of wire is 1×10^{11} N m^{-2}. Original length of the wire is 2 m and the area of cross section is 2 cm^2. The wire will extend in length by _____ μm.

Q24. The position, velocity and acceleration of a particle executing simple harmonic motion are found to have magnitudes of 4 m, 2 ms^{-1} and 16 ms^{-2} at a certain instant. The amplitude of the motion is $\sqrt{x}$, m where x is _____

Q25. At the centre of a half ring of radius R = 10 cm and linear charge density $4\mathrm{nCm}^{-1}$, the potential is $x\pi$V. The value of x is _____

Q26. The current flowing through the 1Ω resistor is $\frac{n}{10}$ A. The value of n is _____



Q27. A square loop of edge length 2 m carrying current of 2 A is placed with its edges parallel to the x y axis. A magnetic field is passing through the $x-y$ plane and expressed as $\vec{B}=B_0(1+4x)\hat{k}$, where $B_0=5$ T. The net magnetic force experienced by the loop is _____ N.

Q28. When a coil is connected across a 20 V dc supply, it draws a current of 5 A. When it is connected across 20 V, 50 Hz ac supply, it draws a current of 4 A. The self inductance of the coil is _____ mH. (Take $\pi=3$)

Q29. In a Young's double slit experiment, the intensity at a point is $\left(\frac{1}{4}\right)^{\text{th}}$ of the maximum intensity, the minimum distance of the point from the central maximum is _____ μm. (Given : $\lambda=600$ nm, d $=1.0$ mm, D $=1.0$ m)

Q30. A star has 100% helium composition. It starts to convert three ^{4}He into one ^{12}C via triple alpha process as $^4\text{He}+{}^4\text{He}+{}^4\text{He}\rightarrow{}^{12}\text{C}+\text{Q}$. The mass of the star is 2.0×10^{32} kg and it generates energy at the rate of 5.808×10^{30} W. The rate of converting these ^{4}He to ^{12}C is $\text{n}\times10^{42}$ s^{-1}, where n is _____ [Take, mass of $^4\text{He}=4.0026$u, mass of $^{12}\text{C}=12$u]

Q31. Compare the energies of following sets of quantum numbers for multielectron system. (A) n $=4,1=1$ (B) n $=4,$ l $=2$ (C) n $=3,1=1$ (D) n $=3,1=2$ (E) n $=4,1=0$ Choose the correct answer from the options given below :

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

Q32. Given below are two statements : Statement (I) : The oxidation state of an element in a particular compound is the charge acquired by its atom on the basis of electron gain enthalpy consideration from other atoms in the molecule. Statement (II) : pπ − pπ bond formation is more prevalent in second period elements over other periods. In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Both Statement I and Statement II are correct
(2) Both Statement I and Statement II are incorrect
(3) Statement I is incorrect but Statement II is correct
(4) Statement I is correct but Statement II is incorrect

Q33. In which one of the following pairs the central atoms exhibit sp^2 hybridization ?

(1) H_2O and NO_2
(2) BF_3 and NO_2^-
(3) NH_2^- and H_2O
(4) NH_2^- and BF_3

Q34. Identify the incorrect statements regarding primary standard of titrimetric analysis. (A) It should be purely available in dry form. (B) It should not undergo chemical change in air. (C) It should be hygroscopic and should react with another chemical instantaneously and stoichiometrically. (D) It should be readily soluble in water. (E) $KMnO_4$ & NaOH can be used as primary standard. Choose the correct answer from the options given below :

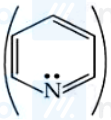
(1) (A) and (B) only
(2) (C) and (E) only
(3) (B) and (E) only
(4) (C) and (D) only

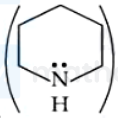
Q35. Methods used for purification of organic compounds are based on :

(1) nature of compound and presence of impurity.
(2) neither on nature of compound nor on the impurity present.
(3) nature of compound only.
(4) presence of impurity only.

Q36.

Correct order of basic strength of Pyrrole 

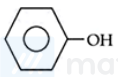
, Pyridine 

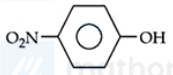
, and Piperidine 

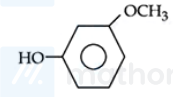
is:

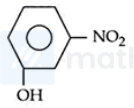
(1) Pyrrole > Piperidine > Pyridine
(2) Pyrrole > Pyridine > Piperidine
(3) Pyridine > Piperidine > Pyrrole
(4) Piperidine > Pyridine > Pyrrole

Q37.

(A) 

(B) 

(C) 

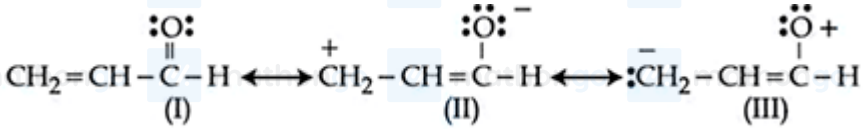
(D) 

(E) 

For the given compounds, the correct order of increasing pK_a value :
Choose the correct answer from the options given below :

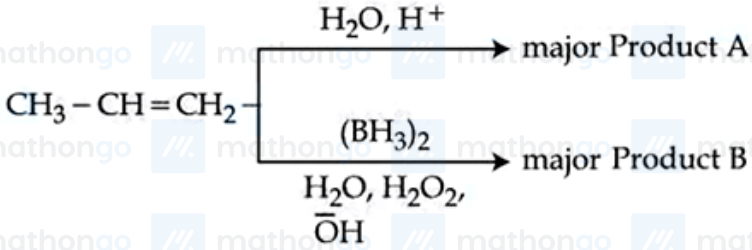
(1) (B) < (D) < (C) < (A) < (E)
(2) (D) < (E) < (C) < (B) < (A)
(3) (E) < (D) < (C) < (B) < (A)
(4) (E) < (D) < (B) < (A) < (C)

Q38. Relative stability of the contributing structures is :



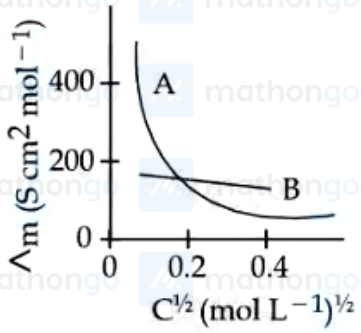
(1) (I) > (II) > (III)
(2) (I) > (III) > (II)
(3) (II) > (I) > (III)
(4) (III) > (II) > (I)

Q39. Identify the product A and product B in the following set of reactions.



(1) A - $CH_3CH_2CH_2-OH$ B - $CH_3CH(OH)-CH_3$
(2) A - $CH_3CH_2CH_3$ B – $CH_3CH_2CH_3$
(3) A – $CH_3CH_2CH_2-OH$ B – $CH_3CH_2CH_2-OH$
(4) A - $CH_3-CH(OH)-CH_3$ B - $CH_3CH_2CH_2-OH$

Q40. The molar conductivity for electrolytes A and B are plotted against $C^{1/2}$ as shown below. Electrolytes A and B respectively are :



(1) A: strong electrolyte ; B: weak electrolyte
(2) A: weak electrolyte ; B: weak electrolyte
(3) A: weak electrolyte ; B: strong electrolyte
(4) A: strong electrolyte ; B: strong electrolyte

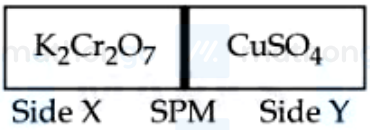
Q41. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A) : Both rhombic and monoclinic sulphur exist as S_8 while oxygen exists as O_2. Reason (R) : Oxygen forms $p\pi - p\pi$ multiple bonds with itself and other elements having small size and high electronegativity like C, N, which is not possible for sulphur. In the light of the above statements, choose the most appropriate answer from the options given below :

(1) (A) is correct but (R) is not correct
(2) (A) is not correct but (R) is correct
(3) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(4) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

Q42. On reaction of Lead Sulphide with dilute nitric acid which of the following is not formed?

(1) Nitric oxide (2) Nitrous oxide
(3) Lead nitrate (4) Sulphur

Q43. $0.05MCuSO_4$ when treated with $0.01MK_2Cr_2O_7$ gives green colour solution of $Cu_2Cr_2O_7$. The two solutions are separated as shown below : [SPM : Semi Permeable Membrane]



Due to osmosis :
(1) Molarity of $CuSO_4$ solution is lowered. (2) Molarity of $K_2Cr_2O_7$ solution is lowered.
(3) Green colour formation observed on side Y. (4) Green colour formation observed on side X.

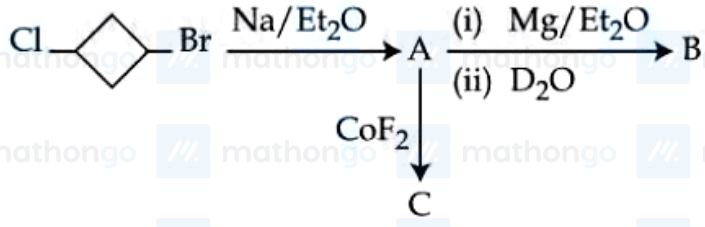
Q44. lectronic configuration of Cu(II) is 3 d^9 whereas that of Cu(I) is 3 d^{10}. Which of the following is correct?
(1) Stability of Cu(I) and Cu(II) depends on nature of copper salts (2) Cu(II) is more stable
(3) Cu(I) and Cu(II) are equally stable (4) Cu (II) is less stable

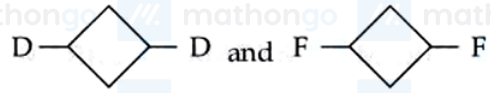
Q45. The F^- ions make the enamel on teeth much harder by converting hydroxyapatite (the enamel on the surface of teeth) into much harder fluoroapatite having the formula.
(1) $[3\,(Ca_3(PO_4)_2)\cdot Ca(OH)_2]$ (2) $[3\,(Ca_3(PO_4)_3)\cdot CaF_2]$
(3) $[3\,(Ca_2(PO_4)_2)\cdot Ca(OH)_2]$ (4) $[3\,(Ca_3(PO_4)_2)\cdot CaF_2]$

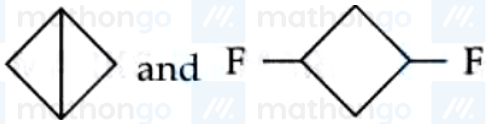
Q46. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : The total number of geometrical isomers shown by $[Co(en)_2Cl_2]^+$complex ion is three. Reason (R): $[Co(en)_2Cl_2]^+$complex ion has an octahedral geometry. In the light of the above statements, choose the most appropriate answer from the options given below :
(1) Both (A) and (R) are correct but (R) is not the correct explanation of (A) (2) (A) is not correct but (R) is correct
(3) Both (A) and (R) are correct and (R) is the correct explanation of (A) (4) (A) is correct but (R) is not correct

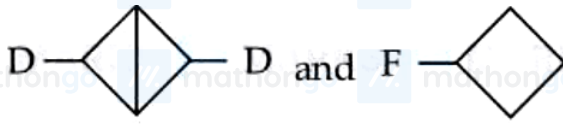
Q47. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): S_N2 reaction of $C_6H_5CH_2Br$ occurs more readily than the S_N2 reaction of CH_3CH_2Br. Reason (R) : The partially bonded unhybridized p-orbital that develops in the trigonal bipyramidal transition state is stabilized by conjugation with the phenyl ring. In the light of the above statements, choose the most appropriate answer from the options given below :
(1) (A) is correct but (R) is not correct (2) (A) is not correct but (R) is correct
(3) Both (A) and (R) are correct but (R) is not the correct explanation of (A) (4) Both (A) and (R) are correct and (R) is the correct explanation of (**A**)

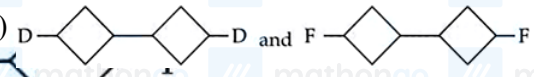
Q48. In the following sequence of reaction, the major products B and C respectively are :



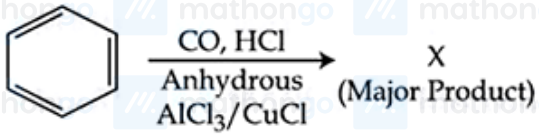
(1) 

(2) 

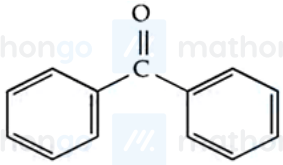
(3) 

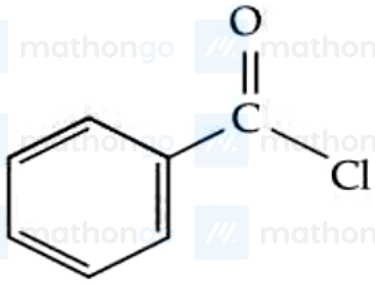
(4) 

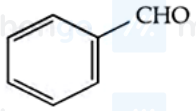
Q49.

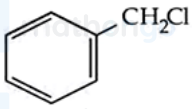


Identify major product " X " formed in the following reaction :

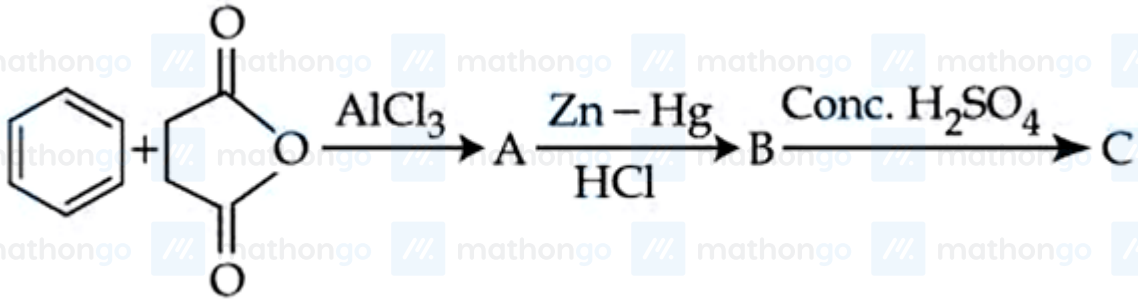
(1) 

(2) 

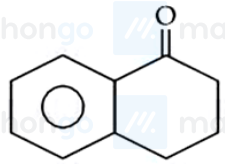
(3) 

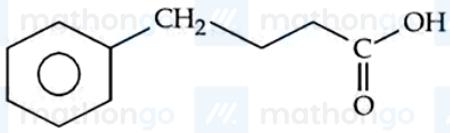
(4) 

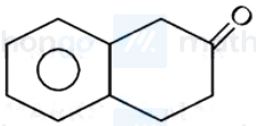
Q50.

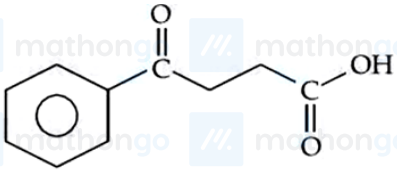


What is the structure of C

(1) 

(2) 

(3) 

(4) 

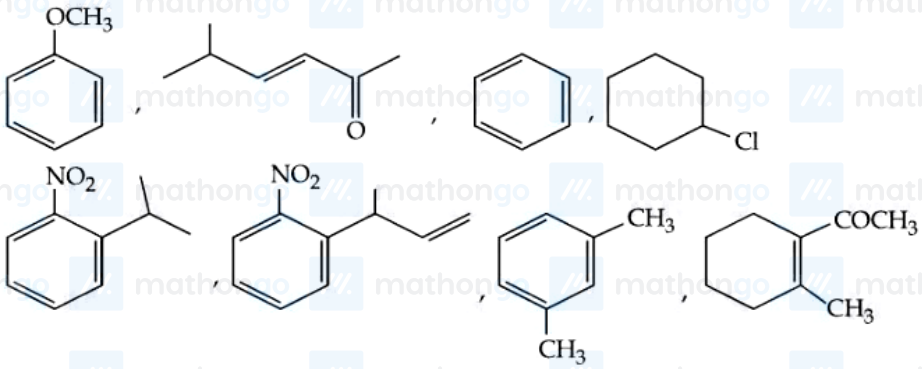
Q51. Molarity (M) of an aqueous solution containing x g of anhyd. $CuSO_4$ in 500 mL solution at $32^\circ C$ is 2×10^{-1}M. Its molality will be _____ $\times 10^{-3}$ m. (nearest integer). [Given density of the solution $= 1.25$ g/mL]

Q52. The total number of species from the following in which one unpaired electron is present, is _____
$N_2, O_2, C_2^-, O_2^-, O_2^{2-}, H_2^+, CN^-, He_2^+$

Q53. When equal volume of 1M HCl and 1M H_2SO_4 are separately neutralised by excess volume of 1M NaOH solution. x and y kJ of heat is liberated respectively. The value of y/x is _____

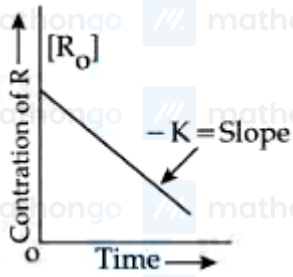
Q54. The heat of solution of anhydrous $CuSO_4$ and $CuSO_4 \cdot 5H_2O$ are -70 kJ mol^{-1} and $+12$ kJ mol^{-1} respectively. The heat of hydration of $CuSO_4$ to $CuSO_4 \cdot 5H_2O$ is $-x$ kJ. The value of x is _____ (nearest integer).

Q55. How many compounds among the following compounds show inductive, mesomeric as well as hyperconjugation effects?



Q56. The standard reduction potentials at 298 K for the following half cells are given below :
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O, E^\circ = 1.33$ V
$Fe^{3+}(aq) + 3e^- \rightarrow Fe \quad E^\circ = -0.04$ V
$Ni^{2+}(aq) + 2e^- \rightarrow Ni \quad E^\circ = -0.25$ V
$Ag^+(aq) + e^- \rightarrow Ag \quad E^\circ = 0.80$ V
$Au^{3+}(aq) + 3e^- \rightarrow Au \quad E^\circ = 1.40$ V
Consider the given electrochemical reactions, The number of metal(s) which will be oxidized be $Cr_2O_7^{2-}$, in aqueous solution is _____

Q57. Given below are two statements : Statement I: The rate law for the reaction $A + B \rightarrow C$ is rate $(r) = k[A]^2[B]$. When the concentration of both A and B is doubled, the reaction rate is increased " x " times. Statement II :



The figure is showing "the variation in concentration against time plot" for a " y " order reaction. The Value of $x+y$ is _____

Q58. Number of colourless lanthanoid ions among the following is _____ $Eu^{3+}, Lu^{3+}, Nd^{3+}, La^{3+}, Sm^{3+}$

Q59. Number of ambidentate ligands among the following is _____ $NO_2^-, SCN^-, C_2O_4^{2-}, NH_3, CN^-, SO_4^{2-}, H_2O$.

Q60. Total number of essential amino acid among the given list of amino acids is _____ Arginine, Phenylalanine, Aspartic acid, Cysteine, Histidine, Valine, Proline

Q61. Let α, β be the roots of the equation $x^2+2\sqrt{2}x-1=0$. The quadratic equation, whose roots are $\alpha^4+\beta^4$ and $\frac{1}{10}\left(\alpha^6+\beta^6\right)$, is :

(1) $x^2-190x+9466=0$ (2) $x^2-180x+9506=0$

(3) $x^2-195x+9506=0$ (4) $x^2-195x+9466=0$

Q62. If the sum of the series $\frac{1}{1\cdot(1+\mathrm{d})}+\frac{1}{(1+\mathrm{d})(1+2\,\mathrm{d})}+\ldots+\frac{1}{(1+9\,\mathrm{d})(1+10\,\mathrm{d})}$ is equal to 5 , then 50 d is equal to :

(1) 10 (2) 5

(3) 15 (4) 20

Q63. The coefficient of x^{70} in $x^2(1+x)^{98}+x^3(1+x)^{97}+x^4(1+x)^{96}+\ldots+x^{54}(1+x)^{46}$ is ${}^{99}\mathrm{C}_\mathrm{p}-{}^{46}\mathrm{C}_\mathrm{q}$. Then a possible value of $p+q$ is :

(1) 55 (2) 83

(3) 61 (4) 68

Q64. Let $|\cos\theta\cos(60-\theta)\cos(60+\theta)|\leq\frac{1}{8}, \theta\epsilon[0,2\pi]$. Then, the sum of all $\theta\epsilon[0,2\pi]$, where $\cos 3\theta$ attains its maximum value, is :

(1) 15π (2) 18π

(3) 6π (4) 9π

Q65. A ray of light coming from the point $P(1,2)$ gets reflected from the point Q on the x-axis and then passes through the point $R(4,3)$. If the point $S(h,k)$ is such that PQRS is a parallelogram, then hk^2 is equal to :

(1) 70 (2) 80

(3) 60 (4) 90

Q66. Let a circle passing through $(2,0)$ have its centre at the point (h,k). Let (x_c,y_c) be the point of intersection of the lines $3x+5y=1$ and $(2+c)x+5c^2y=1$. If $\mathrm{h}=\lim_{\mathrm{c}\to1}x_\mathrm{c}$ and $\mathrm{k}=\lim_{\mathrm{c}\to1}y_\mathrm{c}$, then the equation of the circle is :

(1) $25x^2+25y^2-2x+2y-60=0$ (2) $5x^2+5y^2-4x+2y-12=0$

(3) $5x^2+5y^2-4x-2y-12=0$ (4) $25x^2+25y^2-20x+2y-60=0$

Q67. Let $f(x)=x^2+9, g(x)=\frac{x}{x-9}$ and $\mathrm{a}=f\circ g(10), \mathrm{b}=g\circ f(3)$. If e and l denote the eccentricity and the length of the latus rectum of the ellipse $\frac{x^2}{a}+\frac{y^2}{b}=1$, then $8\mathrm{e}^2+l^2$ is equal to.

(1) 8 (2) 16

(3) 6 (4) 12

Q68. The frequency distribution of the age of students in a class of 40 students is given below.

Age	15	16	17	18	19	20
No of Students	5	8	5	12	x	y

If the mean deviation about the median is 1.25, then $4x+5y$ is equal to :

(1) 46 (2) 43

(3) 44 (4) 47

Q69. Let $\lambda, \mu \in \mathbf{R}$. If the system of equations $\begin{aligned}3x+5y+\lambda z&=3\\7x+11y-9z&=2\\97x+155y-189z&=\mu\end{aligned}$ has infinitely many solutions, then $\mu+2\lambda$ is equal to :

(1) 24 (2) 25

(3) 22 (4) 27

Q70. If the domain of the function $f(x)=\sin^{-1}\left(\frac{x-1}{2x+3}\right)$ is $\mathbf{R}-(\alpha,\beta)$, then $12\alpha\beta$ is equal to :

(1) 32 (2) 40

(3) 24 (4) 36

Q71. Let $f(x)=ax^3+bx^2+cx+41$ be such that $f(1)=40, f'(1)=2$ and $f'(1)=4$. Then $\mathrm{a}^2+\mathrm{b}^2+\mathrm{c}^2$ is equal to:

(1) 73 (2) 62

(3) 51 (4) 54

Q72. A variable line L passes through the point $(3,5)$ and intersects the positive coordinate axes at the points A and B. The minimum area of the triangle OAB, where O is the origin, is :

(1) 30 (2) 25

(3) 40 (4) 35

Q73. Let $\int \frac{2-\tan x}{3+\tan x}\,\mathrm{d}x=\frac{1}{2}(\alpha x+\log_{\mathrm{e}}|\beta\sin x+\gamma\cos x|)+C$, where C is the constant of integration. Then $\alpha+\frac{\gamma}{\beta}$ is equal to :

(1) 7 (2) 4

(3) 1 (4) 3

Q74. The parabola $y^2=4x$ divides the area of the circle $x^2+y^2=5$ in two parts. The area of the smaller part is equal to:

(1) $\frac{1}{3}+5\sin^{-1}\left(\frac{2}{\sqrt{5}}\right)$ (2) $\frac{1}{3}+\sqrt{5}\sin^{-1}\left(\frac{2}{\sqrt{5}}\right)$

(3) $\frac{2}{3}+5\sin^{-1}\left(\frac{2}{\sqrt{5}}\right)$ (4) $\frac{2}{3}+\sqrt{5}\sin^{-1}\left(\frac{2}{\sqrt{5}}\right)$

Q75. The solution curve, of the differential equation $2y\frac{\mathrm{d}y}{\mathrm{d}x}+3=5\frac{\mathrm{d}y}{\mathrm{d}x}$, passing through the point $(0,1)$ is a conic, whose vertex lies on the line:

(1) $2x+3y=9$ (2) $2x+3y=-9$
(3) $2x+3y=-6$ (4) $2x+3y=6$

Q76. The solution of the differential equation $\left(x^2+y^2\right)\mathrm{d}x-5xy\,\mathrm{d}y=0, y(1)=0$, is :
(1) $\left|x^2-2y^2\right|^6=x$ (2) $\left|x^2-4y^2\right|^6=x$
(3) $\left|x^2-4y^2\right|^5=x^2$ (4) $\left|x^2-2y^2\right|^5=x^2$

Q77. Let three vectors $\overrightarrow{\mathrm{a}}=\alpha\hat{i}+4\hat{j}+2\hat{k}, \overrightarrow{\mathrm{b}}=5\hat{i}+3\hat{j}+4\hat{k}, \overrightarrow{\mathrm{c}}=x\hat{i}+y\hat{j}+z\hat{k}$ form a triangle such that $\vec{c}=\vec{a}-\vec{b}$ and the area of the triangle is $5\sqrt{6}$. If α is a positive real number, then $|\vec{c}|^2$ is equal to:
(1) 16 (2) 14
(3) 12 (4) 10

Q78. Let $\overrightarrow{OA}=2\vec{a}, \overrightarrow{OB}=6\vec{a}+5\vec{b}$ and $\overrightarrow{OC}=3\vec{b}$, where O is the origin. If the area of the parallelogram with adjacent sides $\overrightarrow{\mathrm{OA}}$ and $\overrightarrow{\mathrm{OC}}$ is 15 sq. units, then the area (in sq. units) of the quadrilateral OABC is equal to :
(1) 32 (2) 40
(3) 38 (4) 35

Q79. Let the line L intersect the lines $x-2=-y=z-1, 2(x+1)=2(y-1)=z+1$ and be parallel to the line $\frac{x-2}{3}=\frac{y-1}{1}=\frac{z-2}{2}$. Then which of the following points lies on L?
(1) $\left(-\frac{1}{3},1,-1\right)$ (2) $\left(-\frac{1}{3},-1,1\right)$
(3) $\left(-\frac{1}{3},1,1\right)$ (4) $\left(-\frac{1}{3},-1,-1\right)$

Q80. The shortest distance between the lines $\frac{x-3}{4}=\frac{y+7}{-11}=\frac{z-1}{5}$ and $\frac{x-5}{3}=\frac{y-9}{-6}=\frac{z+2}{1}$ is:
(1) $\frac{178}{\sqrt{563}}$ (2) $\frac{187}{\sqrt{563}}$
(3) $\frac{185}{\sqrt{563}}$ (4) $\frac{179}{\sqrt{563}}$

Q81. The sum of the square of the modulus of the elements in the set $\{z=\mathrm{a}+\mathrm{ib}:\mathrm{a},\mathrm{b}\in\mathbf{Z}, z\in\mathbf{C}, |z-1|\leq 1, |z-5|\leq|z-5\mathrm{i}|\}$ is _____

Q82. The remainder when 428^{2024} is divided by 21 is_____

Q83. Let the centre of a circle, passing through the points $(0,0),(1,0)$ and touching the circle $x^2+y^2=9$, be (h,k). Then for all possible values of the coordinates of the centre $(h,k), 4\left(h^2+k^2\right)$ is equal to_____

Q84. Let $\lim_{n\to\infty}\left(\frac{n}{\sqrt{n^4+1}}-\frac{2n}{(n^2+1)\sqrt{n^4+1}}+\frac{n}{\sqrt{n^4+16}}-\frac{8n}{(n^2+4)\sqrt{n^4+16}}+\ldots+\frac{n}{\sqrt{n^4+n^4}}-\frac{2n\cdot n^2}{(n^2+n^2)\sqrt{n^4+n^4}}\right)$ be $\frac{\pi}{k}$, using only the principal values of the inverse trigonometric functions. Then k^2 is equal to _____

Q85. Let $A=\{2,3,6,7\}$ and $B=\{4,5,6,8\}$. Let R be a relation defined on $A\times B$ by $(a_1,b_1)R(a_2,b_2)$ if and only if $a_1+a_2=b_1+b_2$. Then the number of elements in R is _____

Q86. Let A be a non-singular matrix of order 3 . If $\det(3\,\mathrm{adj}(2\,\mathrm{adj}((\det A)A)))=3^{-13}\cdot 2^{-10}$ and $\det(3\,\mathrm{adj}(2\,\mathrm{A}))=2^{\mathrm{m}}\cdot 3^{\mathrm{n}}$, then $|3\,\mathrm{m}+2\mathrm{n}|$ is equal to

Q87. If a function f satisfies $f(\mathrm{m}+\mathrm{n})=f(\mathrm{m})+f(\mathrm{n})$ for all $\mathrm{m},\mathrm{n}\in\mathbf{N}$ and $f(1)=1$, then the largest natural number λ such that $\sum_{k=1}^{2022}f(\lambda+k)\leq(2022)^2$ is equal to _____

Q88. Let $f:(0,\pi)\to\mathbf{R}$ be a function given by $f(x)=\begin{cases}\left(\frac{8}{7}\right)^{\frac{\tan 8x}{\tan 7x}}, & 0<x<\frac{\pi}{2}\\ \mathrm{a}-8, & x=\frac{\pi}{2}\\ (1+|\cot x|)^{\frac{\mathrm{b}}{|\tan x|}}, & \frac{\pi}{2}<x<\pi\end{cases}$ where $\mathrm{a},\mathrm{b}\in\mathbf{Z}$. If f is continuous at $x=\frac{\pi}{2}$, then $\mathrm{a}^2+\mathrm{b}^2$ is equal to

Q89. Let the set of all positive values of λ, for which the point of local minimum of the function $\left(1+x\left(\lambda^2-x^2\right)\right)$ satisfies $\frac{x^2+x+2}{x^2+5x+6}<0$, be (α,β). Then $\alpha^2+\beta^2$ is equal to _____

Q90. Let a, b and c denote the outcome of three independent rolls of a fair tetrahedral die, whose four faces are marked $1,2,3,4$. If the probability that $ax^2+bx+c=0$ has all real roots is $\frac{m}{n}$, $\gcd(\mathrm{m},\mathrm{n})=1$, then $\mathrm{m}+\mathrm{n}$ is equal to _____

ANSWER KEYS

1. (2)	**2.** (2)	**3.** (4)	**4.** (4)	**5.** (2)	**6.** (4)	**7.** (2)	**8.** (3)
9. (3)	**10.** (1)	**11.** (2)	**12.** (2)	**13.** (2)	**14.** (2)	**15.** (1)	**16.** (3)
17. (1)	**18.** (2)	**19.** (3)	**20.** (3)	**21.** (3)	**22.** (100)	**23.** (20)	**24.** (17)
25. (36)	**26.** (25)	**27.** (160)	**28.** (10)	**29.** (200)	**30.** (15)	**31.** (4)	**32.** (3)
33. (2)	**34.** (2)	**35.** (1)	**36.** (4)	**37.** (1)	**38.** (1)	**39.** (4)	**40.** (3)
41. (1)	**42.** (2)	**43.** (1)	**44.** (2)	**45.** (4)	**46.** (2)	**47.** (4)	**48.** (4)
49. (3)	**50.** (1)	**51.** (164)	**52.** (4)	**53.** (2)	**54.** (82)	**55.** (4)	**56.** (3)
57. (8)	**58.** (2)	**59.** (3)	**60.** (4)	**61.** (3)	**62.** (2)	**63.** (2)	**64.** (3)
65. (1)	**66.** (4)	**67.** (1)	**68.** (3)	**69.** (2)	**70.** (1)	**71.** (3)	**72.** (1)
73. (2)	**74.** (3)	**75.** (1)	**76.** (3)	**77.** (2)	**78.** (4)	**79.** (1)	**80.** (2)
81. (9)	**82.** (1)	**83.** (9)	**84.** (32)	**85.** (25)	**86.** (14)	**87.** (1010)	**88.** (81)
89. (39)	**90.** (19)						