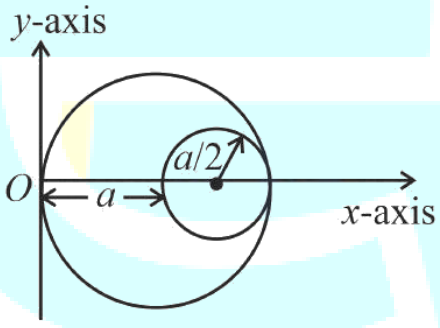
Q1. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$. Measured value of L is 1.0 m from meter scale having a minimum division of 1 mm and time of one complete oscillation is 1.95 s measured from stopwatch of 0.01 s resolution. The percentage error in the determination of $\boldsymbol{g'}$ will be:
(1) 1.03%
(2) 1.33%
(3) 1.30%
(4) 1.13%

Q2. A particle is projected with velocity v_0 along x-axis. A damping force is acting on the particle which is proportional to the square of the distance from the origin i.e. $ma = -\alpha x^2$. The distance at which the particle stops:
(1) $\left(\frac{2v_0}{3\alpha}\right)^{\frac{1}{3}}$
(2) $\left(\frac{3mv_0^2}{2\alpha}\right)^{\frac{1}{3}}$
(3) $\left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{2}}$
(4) $\left(\frac{2v_0^2}{3\alpha}\right)^{\frac{1}{2}}$

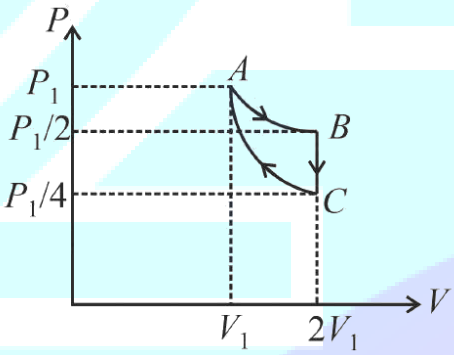
Q3. A circular hole of radius $\left(\frac{a}{2}\right)$ is cut out of a circular disc of radius a as shown in figure. The centroid of the remaining circular portion with respect to point O will be:



(1) $\frac{2}{3}a$
(2) $\frac{5}{6}a$
(3) $\frac{1}{6}a$
(4) $\frac{10}{11}a$

Q4. A body weighs 49 N on a spring balance at the north pole. What will be its weight recorded on the same weighing machine, if it is shifted to the equator?
[Use $g = \frac{GM}{R^2} = 9.8\ \text{m s}^{-2}$ and radius of earth, $R = 6400$ km.]
(1) 49.17 N
(2) 48.83 N
(3) 49.83 N
(4) 49 N

Q5. If one mole of an ideal gas at (P_1, V_1) is allowed to expand reversibly and isothermally (A to B) its pressure is reduced to one-half of the original pressure (see figure). This is followed by a constant volume cooling till its pressure is reduced to one-fourth of the initial value ($B \rightarrow C$). Then it is restored to its initial state by a reversible adiabatic compression (C to A). The net workdone by the gas is equal to:

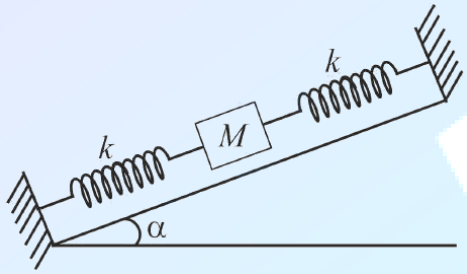


(1) 0
(2) $RT\ln(2)$
(3) $-\frac{RT}{2(\gamma-1)}$
(4) $RT\left[\ln(2) - \frac{1}{2(\gamma-1)}\right]$

Q6. On the basis of kinetic theory of gases, the gas exerts pressure because its molecules:
(1) continuously stick to the walls of container.
(2) suffer change in momentum when impinge on the walls of container.

(3) continuously lose their energy till it reaches wall. (4) are attracted by the walls of container.

Q7. In the given figure, a body of mass M is held between two massless springs, on a smooth inclined plane. The free ends of the springs are attached to firm supports. If each spring has spring constant k, the frequency of oscillation of given body is:



(1) $\frac{1}{2\pi}\sqrt{\frac{2k}{Mg\sin\alpha}}$

(2) $\frac{1}{2\pi}\sqrt{\frac{k}{Mg}\sin\alpha}$

(3) $\frac{1}{2\pi}\sqrt{\frac{k}{2M}}$

(4) $\frac{1}{2\pi}\sqrt{\frac{2k}{M}}$

Q8. When a particle executes SHM, the nature of graphical representation of velocity as a function of displacement is:

(1) straight line
(2) elliptical
(3) circular
(4) parabolic

Q9. Which of the following equations represents a travelling wave?

(1) $y = A\sin(15x - 2t)$
(2) $y = Ae^{x}\cos(\omega t - \theta)$
(3) $y = Ae^{-x^2}(vt + \theta)$
(4) $y = A\sin x\cos\omega t$

Q10. Two electrons each are fixed at a distance $2d$. A third charge proton placed at the midpoint is displaced slightly by a distance $x(x \ll d)$ perpendicular to the line joining the two fixed charges. Proton will execute simple harmonic motion having angular frequency:
(m = mass of charged particle)

(1) $\left(\frac{\pi\varepsilon_0 md^3}{2q^2}\right)^{\frac{1}{2}}$

(2) $\left(\frac{2\pi\varepsilon_0 md^3}{q^2}\right)^{\frac{1}{2}}$

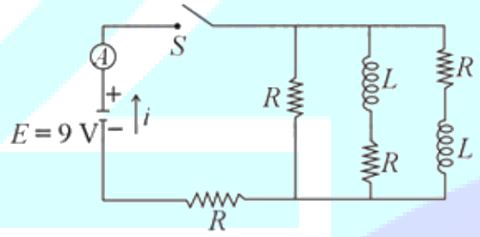
(3) $\left(\frac{q^2}{2\pi\varepsilon_0 md^3}\right)^{\frac{1}{2}}$

(4) $\left(\frac{2q^2}{\pi\varepsilon_0 md^3}\right)^{\frac{1}{2}}$

Q11. A soft ferromagnetic material is placed in an external magnetic field. The magnetic domains:

(1) have no relation with external magnetic field.
(2) decrease in size and changes orientation.
(3) increase in size but no change in orientation.
(4) may increase or decrease in size and change its orientation.

Q12. The figure shows a circuit that contains four identical resistors with resistance $R = 2.0\Omega$, two identical inductors with inductance $L = 2.0$mH and an ideal battery with E.M.F. $E = 9$ V. The current i just after the switch S is closed will be:



(1) 9 A
(2) 3.37 A
(3) 2.25 A
(4) 3.0 A

Q13. An X-ray tube is operated at 1.24 million volt. The shortest wavelength of the produced photon will be:

(1) 10^{-3} nm
(2) 10^{-2} nm
(3) 10^{-4} nm
(4) 10^{-1} nm

Q14. Match List - I with List - II.

List-I
(a) Source of microwave frequency
(b) Source of infrared frequency
(c) Source of Gamma Rays
(d) Source of X-rays
(i) Radioactive decay of nucleus
(ii) Magnetron
(iii) Inner shell electrons
(iv) Vibration of atoms and molecules
(v) LASER
(vi) RC circuit

List-II

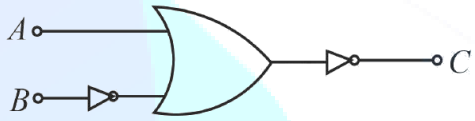
Choose the correct answer from the options given below:
(1) (a)-(ii), (b)-(iv), (c)-(vi), (d)-(iii)
(2) (a)-(vi), (b)-(iv), (c)-(i), (d)-(v)
(3) (a)-(vi), (b)-(v), (c)-(i), (d)-(iv)
(4) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

Q15.If the source of light used in a Young's double slit experiment is changed from red to violet:
(1) consecutive fringe lines will come closer.
(2) the fringes will become brighter.
(3) the central bright fringe will become a dark
(4) the intensity of minima will increase. fringe.

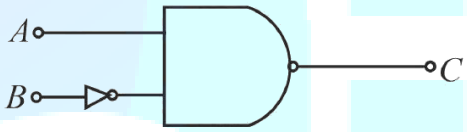
Q16. The de Broglie wavelength of a proton and α-particle are equal. The ratio of their velocities is
(1) 4: 1
(2) 4: 3
(3) 1: 4
(4) 4: 2

Q17. According to Bohr atom model, in which of the following transitions will the frequency be maximum?
(1) $n = 3$ to $n = 2$
(2) $n = 5$ to $n = 4$
(3) $n = 4$ to $n = 3$
(4) $n = 2$ to $n = 1$

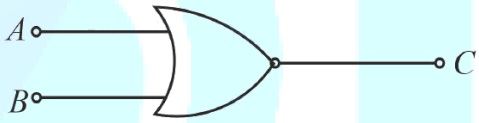
Q18.



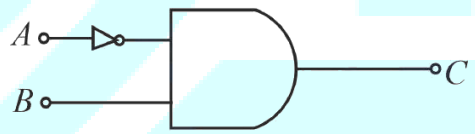
The logic circuit shown above is equivalent to :
(1)



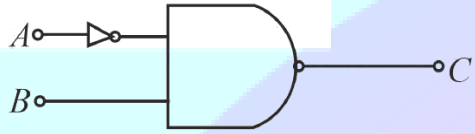
(2)



(3)



(4)



Q19. Zener breakdown occurs in a $p - n$ junction having p and n both:
(1) lightly doped and have narrow depletion layer.
(2) heavily doped and have wide depletion layer.
(3) lightly doped and have wide depletion layer.
(4) heavily doped and have narrow depletion layer.

Q20. Given below are two statements:
Statement I : $p-n$ junction diodes can be used to function as a transistor, simply by connecting two diodes, back to back, which acts as the base terminal
Statement II: In the study of transistors, the amplification factor β indicates ratio of the collector current to the base current.
In the light of the above statements, choose the correct answer from the options given below.
(1) Both Statement I and Statement II are false
(2) Statement I is true but Statement II is false
(3) Statement I is false but Statement II is true
(4) Both Statement I and Statement II are true

Q21. Two solids A and B of mass 1 kg and 2 kg respectively are moving with equal linear momentum. The ratio of their kinetic energies $(K.E.)_A:(K.E.)_B$ will be $\frac{A}{1}$, so the value of A will be .

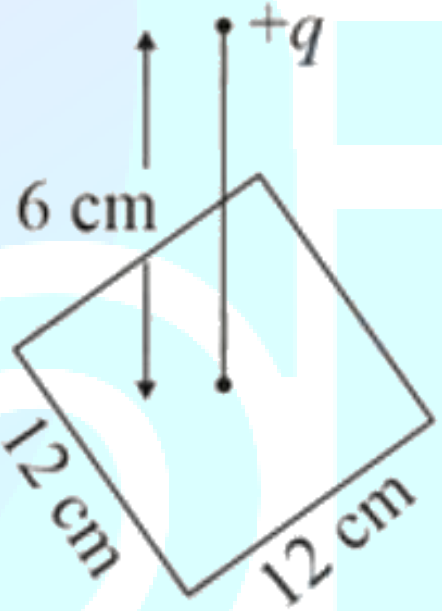
Q22. A uniform thin bar of mass 6 kg and length 2.4 meter is bent to make an equilateral hexagon. The moment of inertia about an axis passing through the centre of mass and perpendicular to the plane of hexagon is
$\times 10^{-1}$ kg m^2.

Q23. A uniform metallic wire is elongated by 0.04 m when subjected to a linear force F. The elongation, if its length and diameter is doubled and subjected to the same force will be cm .

Q24. The root-mean-square speed of molecules of a given mass of a gas at 27°C and 1 atmosphere pressure is 200 m s^{-1}. The root-mean-square speed of molecules of the gas at 127°C and 2 atmosphere pressure is $\frac{x}{\sqrt{3}}$ m s^{-1}. The value of x will be .

Q25. Two cars are approaching each other at an equal speed of 7.2 kmhr^{-1}. When they see each other, both blow horns having a frequency of 676 Hz . The beat frequency heard by each driver will be Hz. [Velocity of sound in air is 340 m s^{-1}.

Q26. A point charge of $+12\mu$C is at a distance 6 cm vertically above the centre of a square of side 12 cm as shown in figure. The magnitude of the electric flux through the square will be $\times 10^3$ N m^{2}C^{-1}.



Q27. A cylindrical wire of radius 0.5 mm and conductivity 5×10^7 S m^{-1} is subjected to an electric field of 10mVm^{-1}. The expected value of current in the wire will be $x^3\pi$ mA. The value of x is .

Q28. A series LCR circuit is designed to resonate at an angular frequency $\omega_0 = 10^5$rads^{-1}. The circuit draws 16 W power from 120 V source at resonance. The value of resistance R in the circuit is Ω 。

Q29. An electromagnetic wave of frequency 3 GHz enters a dielectric medium of relative electric permittivity 2.25 from vacuum. The wavelength of this wave in that medium will be $\times 10^{-2}$ cm.

Q30. A signal of 0.1 kW is transmitted in a cable. The attenuation of cable is -5 dB per km and cable length is 20 km . The power received at the receiver is 10^{-x} W. The value of x is .
[Gain in dB $= 10\log_{10}\left(\frac{P_O}{P_i}\right)$]

Q31. According to Bohr's atomic theory:
(A) Kinetic energy of electron is $\propto \frac{Z^2}{n^2}$.
(B) The product of velocity (v) of electron and principal quantum number (n), $/vn/\propto Z^2$.
(C) Frequency of revolution of electron in an orbit is $\propto \frac{Z^3}{n^3}$.
(D) Coulombic force of attraction on the electron is $\propto \frac{Z^3}{n^4}$.

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

Q32. The correct set from the following in which both pairs are in correct order of melting point is:
(1) $LiF > LiCl; NaCl > MgO$
(2) $LiCl > LiF; MgO > NaCl$
(3) $LiCl > LiF; NaCl > MgO$
(4) $LiF > LiCl; MgO > NaCl$

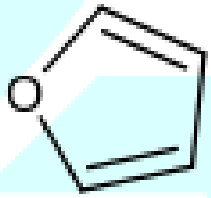
Q33. The correct shape and $I-I-I$ bond angles respectively in I_3^- ion are:
(1) T-shaped; 180° and 90°
(2) Distorted trigonal planar; 135° and 90°
(3) Trigonal planar; 120°
(4) Linear; 180°

Q34. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A: Hydrogen is the most abundant element in the Universe, but it is not the most abundant gas in the troposphere.
Reason R: Hydrogen is the lightest element.
In the light of the above statements, choose the correct answer from the options given below:
(1) Both A and R are true but R is NOT the correct explanation of A
(2) Both A and R are true and R is the correct explanation of A
(3) *A* is true but *R* is false
(4) A is false but *R* true

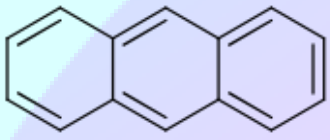
Q35. Match List - I with List - II.
List-I (Salt) List-II (Flame colour wavelength)
(a) LiCl
(i)
455.5 nm
(b) NaCl
(ii)
670.8 nm
(c) RbCl
(iii)
780.0 nm
(d) CsCl
(iv)
589.2 nm

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

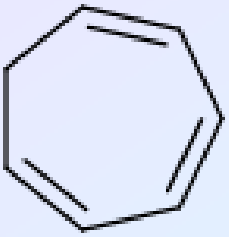
Q36. Which one of the following compounds is non-aromatic?
(1)



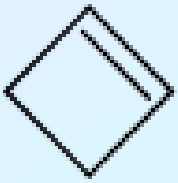
(2)



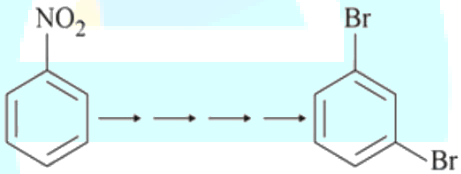
(3)



(4)



Q37. What is the correct sequence of reagents used for converting nitrobenzene into m - dibromobenzene?



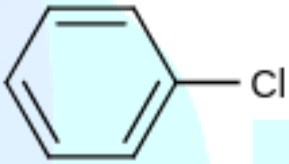
(1) $\xrightarrow{Sn/HCl} / \xrightarrow{KBr} / \xrightarrow{Br_2} / \xrightarrow{H^+}$

(2) $\xrightarrow{Br_2/Fe} / \xrightarrow{Sn/HCl} / \xrightarrow{NaNO_2/HCl} / \xrightarrow{CuBr/HBr}$

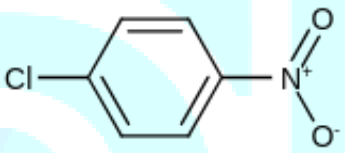
(3) $\xrightarrow{NaNO_2} / \xrightarrow{HCl} / \xrightarrow{KBr} / \xrightarrow{H^+}$

(4) $\xrightarrow{Sn/HCl} / \xrightarrow{Br_2} / \xrightarrow{NaNO_2} / \xrightarrow{NaBr}$

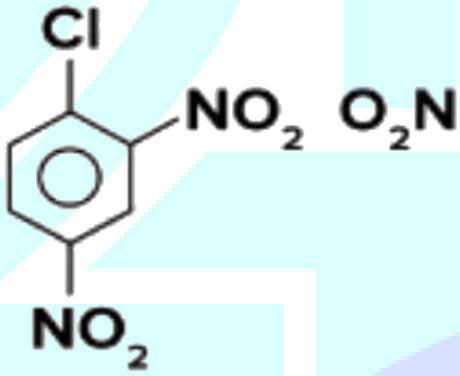
Q38. The correct order of the following compounds showing increasing tendency towards nucleophilic substitution reaction is:



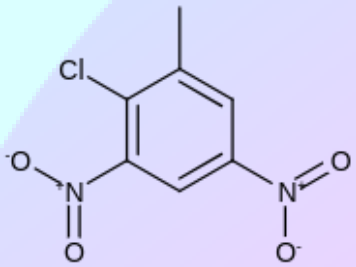
(i)



(ii)



(iii)



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

Q39. Given below are two statements:
Statement I: The value of the parameter "Biochemical Oxygen Demand (BOD)" is important for survival of aquatic life.
Statement II: The optimum value of BOD is 6.5 ppm .
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) Statement I is true but Statement II is false
(2) Statement I is false but Statement II is true
(3) Both Statement I and Statement II are false
(4) Both Statement I and Statement II are true

Q40. Most suitable salt which can be used for efficient clotting of blood will be?
(1) $FeCl_3$
(2) $Mg(HCO_3)_2$
(3) $FeSO_4$
(4) $NaHCO_3$

Q41. Match List - I with List - II.

List-I (Metal)
(a) Aluminium
(b) Iron
(c) Copper
(d) Zinc

List-II (Ores)

(i) Siderite
(ii) Calamine
(iii) Kaolinite
(iv) Malachite

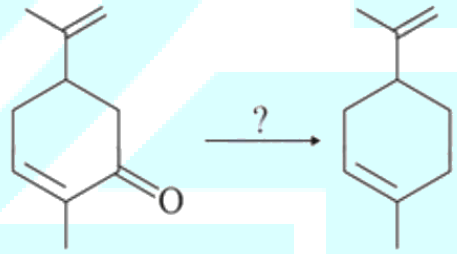
Choose the correct answer from the options given below:
(1) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)
(2) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)
(3) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
(4) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

Q42. The incorrect statement among the following is:
(1) Cr_2O_3 is an amphoteric oxide
(2) $VOSO_4$ is a reducing agent
(3) RuO_4 is an oxidizing agent
(4) Red colour of ruby is due to the presence of Co^{3+}

Q43. What is the correct order of the following elements with respect to their density?
(1) $Zn < Cu < Co < Fe < Cr$
(2) $Cr < Zn < Co < Cu < Fe$
(3) $Zn < Cr < Fe < Co < Cu$
(4) $Cr < Fe < Co < Cu < Zn$

Q44. The calculated magnetic moments (spin only value) for species $[FeCl_4]^{2-}$, $[Co(C_2O_4)_3]^{3-}$ and MnO_4^{2-} respectively are:
(1) 4.90,0 and 1.73 BM
(2) 4.90,0 and 2.83 BM
(3) 5.82,0 and 0 BM
(4) 5.92,4.90 and 0 BM

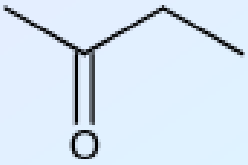
Q45.



Which of the following reagent is suitable for the preparation of the product in the above reaction?
(1) Red $P + Cl_2$
(2) $NaBH_4$
(3) $NH_2 - NH_2/C_2H_5\overset{\ominus}{O}\overset{\oplus}{Na}$
(4) Ni/H_2

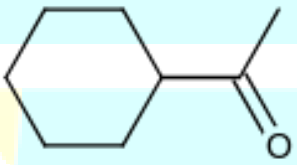
Q46. Which one of the following carbonyl compounds cannot be prepared by addition of water on an alkyne in the presence of $HgSO_4$ and H_2SO_4 ?
(1)

(2)



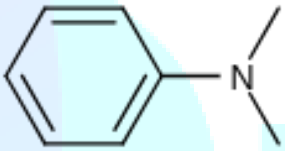
(3)

(4)

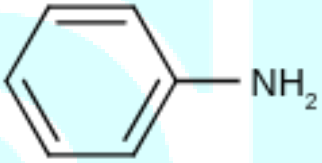


Q47. The diazonium salt of which of the following compounds will form a coloured dye on reaction with β Naphthol in NaOH ?

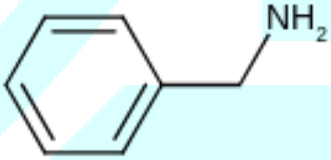
(1)



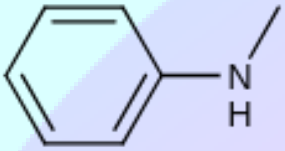
(2)



(3)



(4)



Q48. Match List - I with List - II.

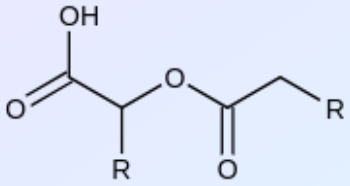
List-I (Salt)

List-II (Flame colour wavelength)

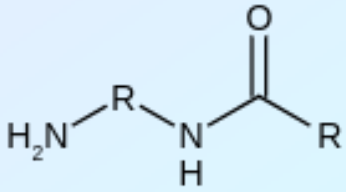
(a)

(i) $Br_2/NaOH$

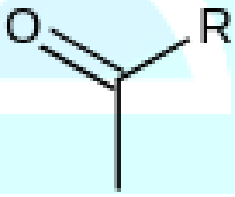
(b)



(ii) $H_2/Pd - BaSO_4$
(c)



(iii) $Zn(Hg)/$ Conc. HCl
(d)



(iv) $Cl_2/RedP, H_2O$

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

Q49. In polymer Buna-S :/S/ stands for:
(1) Strength
(2) Sulphur
(3) Sulphonation
(4) Styrene

Q50. Match List - I with List - II.

List-I

(a) Valium
(b) Morphine
(c) Norethindrone
(d) Vitamin B_{12}

List-II

(i) Antifertility drug
(ii) Pernicious anaemia
(iii) Analgesic
(iv) Tranquilizer
(1) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)
(2) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)
(3) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)
(4) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

Q51. The formula of a gaseous hydrocarbon which requires 6 times of its own volume of O_2 for complete oxidation and produces 4 times its own volume of CO_2 is C_xH_y. The value of y is .

Q52.1.86 g of aniline completely reacts to form acetanilide. 10% of the product is lost during purification. Amount of acetanilide obtained after purification (in g) is $\times 10^{-2}$.

Q53. The volume occupied by 4.75 g of acetylene gas at $50^{\circ}C$ and 740 mm Hg pressure is L. (Rounded off to the nearest integer)
[Given R = 0.0826 L atm K^{-1} mol^{-1}]
Q54. Assuming ideal behaviour, the magnitude of log K for the following reaction at $25^{\circ}C$ is x $\times 10^{-1}$. The value of x is . (Integer answer)
$3HC \equiv CH_{(g)} \rightleftharpoons C_6H_{6(l)}$
[Given:
$\Delta_f G^{\circ}(HC \equiv CH) = -2.04 \times 10^5$ J mol^{-1}; $\Delta_f G^{\circ}(C_6H_6) = -1.24 \times 10^5$ J mol^{-1}; R = 8.314 J K^{-1} mol^{-1}]

Q55. The solubility product of PbI_2 is 8.0×10^{-9}. The solubility of lead iodide in 0.1 molar solution of lead nitrate is $x \times 10^{-6}$ mol/L. The value of x is (Rounded off to the nearest integer) [Given $\sqrt{2} = 1.41$]

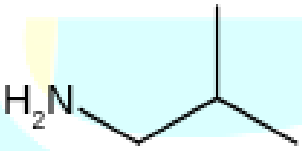
Q56. C_6H_6 freezes at 5.5°C. The temperature at which a solution of 10 g of C_4H_{10} in 200 g of C_6H_6 freeze is
°C. (nearest integer value), (The molal freezing point depression constant of C_6H_6 is 5.12 °C/m.)

Q57. The magnitude of the change in oxidising power of the MnO_4^-/Mn^{2+} couple is $x \times 10^{-4}$ V if the H^+ concentration is decreased from 1 M to 10^{-4}M at 25°C. (Assume concentration of MnO_4^- and Mn^{2+} to be same on change in H^+concentration). The value of x is →
(Rounded off to the nearest integer)
[Given: $\frac{2.303RT}{F} = 0.059$]

Q58. Sucrose hydrolyses in acid solution into glucose and fructose following first order rate law with a half-life of 3.33 h at 25°C. After 9 h , the fraction of sucrose remaining is f . The value of $\log_{10}\left(\frac{1}{f}\right)$ is × 10^{-2}. (Rounded off to the nearest integer)
[Assume: $\ln 10 = 2.303, \ln 2 = 0.693$]

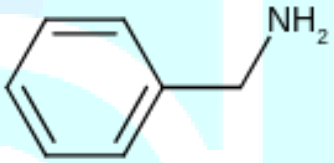
Q59. Among the following allotropic forms of sulphur, the number of allotropic forms, which will show paramagnetism is .
(A) α-sulphur
(B) β-sulphur
(C) S_2-form

Q60. The total number of amines among the following which can be synthesized by Gabriel synthesis is .
(A)

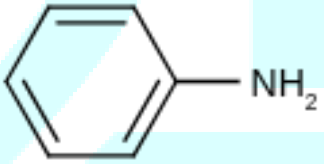


(B)

(C)



(D)



Q61. Let a, b, c be in arithmetic progression. Let the centroid of the triangle with vertices $(a, c), (2, b)$ and (a, b) be $\left(\frac{10}{3}, \frac{7}{3}\right)$. If α, β are the roots of the equation $ax^2 + bx + 1 = 0$, then the value of $\alpha^2 + \beta^2 - \alpha\beta$ is:
(1) $-\frac{71}{256}$
(2) $\frac{69}{256}$
(3) $\frac{71}{256}$
(4) $-\frac{69}{256}$

Q62.If $n \geqslant 2$ is a positive integer, then the sum of the series ${}^{n+1}C_2 + 2({}^2C_2 + {}^3C_2 + {}^4C_2 + \cdots + {}^nC_2)$ is
(1) $\frac{n(n-1)(2n+1)}{6}$
(2) $\frac{n(n+1)(2n+1)}{6}$

(3) $\frac{n(n+1)^2(n+2)}{12}$
(4) $\frac{n(2n+1)(3n+1)}{6}$

Q63. If P is a point on the parabola $y = x^2 + 4$ which is closest to the straight line $y = 4x - 1$, then the coordinates of P are:
(1) $(-2,8)$
(2) $(1,5)$
(3) $(2,8)$
(4) $(3,13)$

Q64. The negation of the statement $\sim p \wedge (p \vee q)$ is:
(1) $\sim p \vee q$
(2) $\sim p \wedge q$
(3) $p \vee \sim q$
(4) $p \wedge \sim q$

Q65. For the statements p and q, consider the following compound statements:
(a) $(\sim q \wedge (p \to q)) \to \sim p$
(b) $((p \vee q) \wedge \sim p) \to q$

Then which of the following statements is correct?
(1) (b) is a tautology but not (a).
(2) (a) and (b) both are tautologies.
(3) (a) and (b) both are not tautologies.
(4) (a) is a tautology but not (b).

Q66. The angle of elevation of a jet plane from a point A on the ground is $60°$. After a flight of 20 seconds at the speed of 432 km / hour, the angle of elevation changes to $30°$. If the jet plane is flying at a constant height, then its height is:
(1) $1200\sqrt{3}$ m
(2) $2400\sqrt{3}$ m
(3) $1800\sqrt{3}$ m
(4) $3600\sqrt{3}$ m

Q67.For the system of linear equations: $x - 2y = 1, x - y + kz = -2, ky + 4z = 6, k \in R$
Consider the following statements:
(A) The system has unique solution if $k \neq 2, k \neq -2$.
(B) The system has unique solution if $k = -2$.
(C) The system has unique solution if $k = 2$.
(D) The system has no-solution if $k = 2$.
(E) The system has infinite number of solutions if $k \neq -2$.

Which of the following statements are correct?
(1) (A) and (E) only
(2) (B) and (E) only
(3) (A) and (D) only
(4) (C) and (D) only

Q68. Let A and B be 3×3 real matrices such that A is a symmetric matrix and B is a skew-symmetric matrix. Then the system of linear equations $(A^2B^2 - B^2A^2)X = O$, where X is a 3×1 column matrix of unknown variables and O is a 3×1 null matrix, has
(1) exactly two solutions
(2) infinitely many solutions
(3) a unique solution
(4) no solution

Q69. A possible value of $\tan\left(\frac{1}{4}\sin^{-1}\frac{\sqrt{63}}{8}\right)$ is:
(1) $2\sqrt{2} - 1$
(2) $\frac{1}{2\sqrt{2}}$
(3) $\sqrt{7} - 1$
(4) $\frac{1}{\sqrt{7}}$

Q70. For which of the following curves, the line $x + \sqrt{3}y = 2\sqrt{3}$ is the tangent at the point $\left(\frac{3\sqrt{3}}{2}, \frac{1}{2}\right)$?
(1) $2x^2 - 18y^2 = 9$
(2) $y^2 = \frac{1}{6\sqrt{3}}x$
(3) $x^2 + 9y^2 = 9$
(4) $x^2 + y^2 = 7$

Q71. Let $f: R \to R$ be defined as

$$f(x) = \begin{cases} -55x, & \text{if } x < -5 \\ 2x^3 - 3x^2 - 120x, & \text{if } -5 \leq x \leq 4 \\ 2x^3 - 3x^2 - 36x - 336, & \text{if } x > 4 \end{cases}$$

Let $A = \{x \in R: f \text{ is increasing }\}$. Then A is equal to:
(1) $(-5, \infty)$
(2) $(-5, -4) \cup (4, \infty)$
(3) $(-\infty, -5) \cup (-4, \infty)$
(4) $(-\infty, -5) \cup (4, \infty)$

Q72. If the curve $y = ax^2 + bx + c, x \in R$, passes through the point $(1,2)$ and the tangent line to this curve at origin is $y = x$, then the possible values of a, b, c are:

(1) $a=-1, b=1, c=1$
(2) $a=1, b=0, c=1$
(3) $a=1, b=1, c=0$
(4) $a=\frac{1}{2}, b=\frac{1}{2}, c=1$

Q73. The value of the integral, $\int_1^3 [x^2-2x-2]dx$, where $[x]$ denotes the greatest integer less than or equal to x, is
(1) -4
(2) -5
(3) $-\sqrt{2}-\sqrt{3}+1$
(4) $-\sqrt{2}-\sqrt{3}-1$

Q74. The area of the region: $R=\{(x,y): 5x^2 \leq y \leq 2x^2+9\}$ is
(1) $9\sqrt{3}$ square units
(2) $12\sqrt{3}$ square units
(3) $11\sqrt{3}$ square units
(4) $6\sqrt{3}$ square units

Q75. Let f be a twice differentiable function defined on R such that $f(0)=1, f'(0)=2$ and $f'(x)\neq 0$ for all $x\in R$. If $\begin{vmatrix} f(x) & f'(x) \\ f'(x) & f''(x) \end{vmatrix}=0$, for all $x\in R$, then the value of $f(1)$ lies in the interval
(1) (9,12)
(2) (3,6)
(3) (0,3)
(4) (6,9)

Q76. If a curve $y=f(x)$ passes through the point (1,2) and satisfies $x\frac{dy}{dx}+y=bx^4$, then for what value of b, $\int_1^2 f(x)dx=\frac{62}{5}$?
(1) $\frac{31}{5}$
(2) 10
(3) 5
(4) $\frac{62}{5}$

Q77. Let $f(x)$ be a differentiable function defined on [0,2] such that $f'(x)=f'(2-x)$ for all $x\in(0,2), f(0)=1$ and $f(2)=e^2$. Then the value of $\int_0^2 f(x)dx$ is
(1) $2(1+e^2)$
(2) $1+e^2$
(3) $1-e^2$
(4) $2(1-e^2)$

Q78. The vector equation of the plane passing through the intersection of the planes $\vec{r}\cdot(\hat{\imath}+\hat{\jmath}+\hat{k})=1$ and $\vec{r}\cdot(\hat{\imath}-2\hat{\jmath})=-2$, and the point (1,0,2) is:
(1) $\vec{r}\cdot(\hat{\imath}+7\hat{\jmath}+3\hat{k})=7$
(2) $\vec{r}\cdot(\hat{\imath}-7\hat{\jmath}+3\hat{k})=\frac{7}{3}$
(3) $\vec{r}\cdot(\hat{\imath}+7\hat{\jmath}+3\hat{k})=\frac{7}{3}$
(4) $\vec{r}\cdot(3\hat{\imath}+7\hat{\jmath}+3\hat{k})=7$

Q79. Let $a,b\in R$. If the mirror image of the point $P(a,6,9)$ with respect to the line $\frac{x-3}{7}=\frac{y-2}{5}=\frac{z-1}{-9}$ is $(20, b, -a-9)$, then $|a+b|$ is equal to:
(1) 86
(2) 90
(3) 84
(4) 88

Q80. The probability that two randomly selected subsets of the set {1,2,3,4,5} have exactly two elements in their intersection, is:
(1) $\frac{65}{2^8}$
(2) $\frac{65}{2^7}$
(3) $\frac{35}{2^7}$
(4) $\frac{135}{2^9}$

Q81. The number of the real roots of the equation $(x+1)^2+|x-5|=\frac{27}{4}$ is .

Q82. Let $i=\sqrt{-1}$. If $\frac{(-1+i\sqrt{3})^{21}}{(1-i)^{24}}+\frac{(1+i\sqrt{3})^{21}}{(1+i)^{24}}=k$, and $n=[|k|]$ be the greatest integral part of $|k|$. Then $\sum_{j=0}^{n+5}(j+5)^2-\sum_{j=0}^{n+5}(j+5)$ is equal to .

Q83. The students $S_1, S_2, \ldots, S_{10}$ are to be divided into 3 groups A, B and C such that each group has at least one student and the group C has at most 3 students. Then the total number of possibilities of forming such groups is .

Q84. The sum of first four terms of a geometric progression (G.P.) is $\frac{65}{12}$ and the sum of their respective reciprocals is $\frac{65}{18}$. If the product of first three terms of the G.P. is 1 , and the third term is α, then 2α is .

Q85. For integers n and r, let $\binom{n}{r} = \begin{cases} {}^{n}C_{r}, & \text{if } n \geq r \geq 0 \\ 0, & \text{otherwise} \end{cases}$. The maximum value of k for which the sum $\sum_{i=0}^{k}\binom{10}{i}\binom{15}{k-i} + \sum_{i=0}^{k+1}\binom{12}{i}\binom{13}{k+1-i}$ is maximum, is equal to .

Q86. Let a point P be such that its distance from the point $(5,0)$ is thrice the distance of P from the point $(-5,0)$. If the locus of the point P is a circle of radius r, then $4r^2$ (in the nearest integer) is equal to .

Q87. If the variance of 10 natural numbers $1,1,1,\ldots,1,k$ is less than 10 , then the maximum possible value of k is .

Q88. If $a+\alpha = 1, b+\beta = 2$ and $af(x) + \alpha f\left(\frac{1}{x}\right) = bx + \frac{\beta}{x}, x \neq 0$, then the value of the expression $\frac{f(x)+f\left(\frac{1}{x}\right)}{x+\frac{1}{x}}$ is .

Q89. If the area of the triangle formed by the x-axis, the normal and the tangent to the circle $(x-2)^2 + (y-3)^2 = 25$ at the point $(5,7)$ is A, then $24A$ is equal to $-$

Q90. Let λ be an integer. If the shortest distance between the lines $x-\lambda = 2y-1 = -2z$ and $x = y+2\lambda = z-\lambda$ is $\frac{\sqrt{7}}{2\sqrt{2}}$, then the value of $|\lambda|$ is $-$

ANSWER KEYS

1. (4) ath	2. (2)	3. (2)	4. (2)	5. (4) athoi	6. (2)	ma 7. (4)	8. (2)
9. (1)	10. (3)	11. (4)	12. (3)	13. (1)	14. (4)	15. (1)	16. (1)
17. (4)	18. (3)	mat 19. (4)	20. (3)	21. (2)	22. (8)	mo 23. (2)	24. (400)
25. (8)	26. (226)	27. (5)	28. (900)	29. (667)	30. (8)	31. (2)	32. (4)
33. (4)	34. (2)	35. (4)	36. (3)	37. (2)	38. (2)	39. (1)	40. (1)
41. (4)	42. (4)	43. (3)	44. (1)	45. (3)	46. (1)	47. (2)	48. (1)
49. (4)	50. (4)	51. (8)	52. (243)	53. (5)	54. (855)	55. (141)	56. (1)
57. (3776)	58. (81)	59. (1)	60. (3)	61. (1)	62. (2)	mo63. (3)	64. (3)
65. (2)	66. (1)	67. (3)	68. (2)	69. (4)	70. (3)	71. (2)	72. (3)
73. (4)	74. (2)	75. (4)	76. (2)	77. (2)	78. (1)	79. (4)	80. (4)
81. (2)	82. (310)	83. (31650)	84. (3)	85. (12)	86. (56)	87. (11)	88. (2)
89. (1225)	90. (1)						