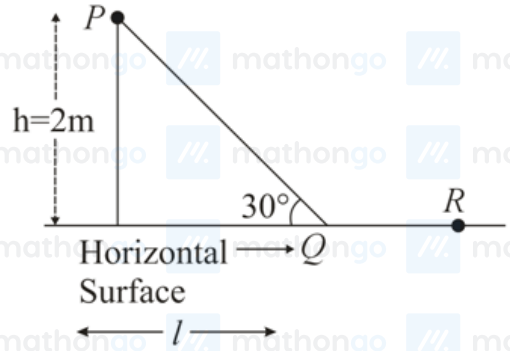
Q1. A student measures the time period of 100 oscillations of a simple pendulum four times. The data set is 90 s, 91 s, 95 s and 92 s. If the minimum division in the measuring clock is 1 s, then the reported mean time should be:

(1) 92 ± 1.8 s (2) 92 ± 3 s

(3) 92 ± 2 s (4) 92 ± 5.0 s

Q2. A point particle of mass m, moves along the uniformly rough track PQR as shown in the figure. The coefficient of friction, between the particle and the rough track equals μ . The particle is released, from rest, from the point P and it comes to rest at a point R. The energies, lost by the ball, over the parts, PQ and QR, of the track, are equal to each other, and no energy is lost when particle changes direction from PQ to QR.

The values of the coefficient of friction μ and the distance $x = (QR)$, are respectively close to:



(1) 0.29 and 3.5 m (2) 0.29 and 6.5 m

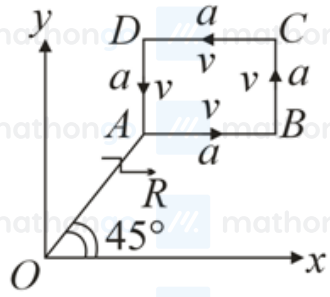
(3) 0.2 and 6.5 m (4) 0.2 and 3.5 m

Q3. A person trying to lose weight by burning fat lifts a mass of 10 kg upto a height of 1m 1000 times. Assume that the potential energy lost each time he lowers the mass is dissipated. How much fat will he use up considering the work done only when the weight is lifted up? Fat supplies 3.8×10^7 J of energy per kg which is converted to mechanical energy with a 20% efficiency rate. Take $g = 9.8\ ms^{-2}$:

(1) 9.89×10^{-3} kg (2) 12.89×10^{-3} kg

(3) 2.45×10^{-3} kg (4) 6.45×10^{-3} kg

Q4. A particle of mass m is moving along the side of a square of side 'a', with a uniform speed υ in the x-y plane as shown in the figure:



Which of the following statements is false for the angular momentum $\vec{L}$ about the origin?

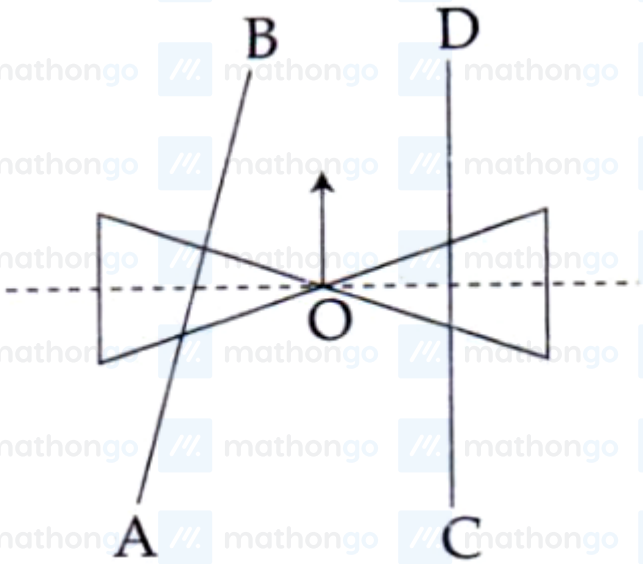
(1) $\overrightarrow{L} = mv\left[\frac{R}{\sqrt{2}} + a\right]\hat{k}$
when the particle is moving from B to C.

(2) $\overrightarrow{L} = \frac{mv}{\sqrt{2}}R\hat{k}$
when the particle is moving from D to A.

(3) $\overrightarrow{L} = -\frac{mv}{\sqrt{2}}R\hat{k}$
when the particle is moving from A to B.

(4) $\overrightarrow{L} = mv\left[\frac{R}{\sqrt{2}} + a\right]\hat{k}$
when the particle is moving from C to D.

Q5. A roller is made by joining together two cones at their vertices O. It is kept on two rails AB and CD which are placed asymmetrically (see figure), with its axis perpendicular to CD and its centre O at the centre of line joining AB and CD (see figure). It is given a light push so that it starts rolling with its centre O moving parallel to CD in the direction shown. As it moves, the roller will tend to:



(1) go straight.
(2) turn left and right alternately.
(3) turn left.
(4) turn right.

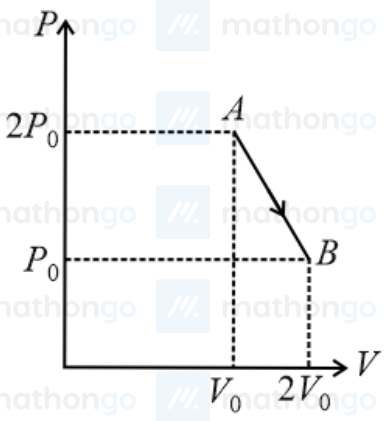
Q6. A satellite is revolving in a circular orbit at a height h from the earth's surface (radius of earth R; h<<R). The minimum increase in its orbital velocity required, so that the satellite could escape from the earth's gravitational field, is close to (Neglect the effect of atmosphere.)

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

Q7. A pendulum clock loses 12 s a day if the temperature is 40° C and gains 4s a day if the temperature is 20° C. The temperature at which the clock will show correct time, and the co-efficient of linear expansion (α) of the metal of the pendulum shaft are respectively:

(1) $30^{o}C; \alpha = 1.85 \times 10^{-3}$ / °C
(2) $55^{o}C; \alpha = 1.85 \times 10^{-2}$ / °C
(3) $25^{o}C; \alpha = 1.85 \times 10^{-5}$ / °C
(4) $60^{o}C; \alpha = 1.85 \times 10^{-4}$ / °C

Q8. n moles of an ideal gas undergoes a process A → B as shown in the figure. The maximum temperature of the gas during the process will be:



(1) $\frac{9\,P_0V_0}{2nR}$ (2) $\frac{9\,P_0V_0}{nR}$
(3) $\frac{9\,P_0V_0}{4nR}$ (4) $\frac{3\,P_0V_0}{2nR}$

Q9. An ideal gas undergoes a quasi-static, reversible process in which its molar heat capacity C remains constant. If during this process the relation of pressure P and volume V is given by PV^n = constant, then n is given by (Here C_P and C_V are molar specific heat at constant pressure and constant volume, respectively) :

(1) $n = \frac{C_P - C}{C - C_V}$ (2) $n = \frac{C - C_V}{C - C_P}$
(3) $n = \frac{C_P}{C_V}$ (4) $n = \frac{C - C_P}{C - C_V}$

Q10. A particle performs simple harmonic motion with amplitude A. Its speed is tripled at the instant that it is at a distance $\frac{2A}{3}$ from equilibrium position. The new amplitude of the motion is:

(1) $A\sqrt{3}$ (2) $\frac{7A}{3}$
(3) $\frac{A}{3}\sqrt{41}$ (4) $3A$

Q11. A pipe open at both ends has a fundamental frequency f in air. The pipe is dipped vertically in water so that half of it is in water. The fundamental frequency of the air column is now:

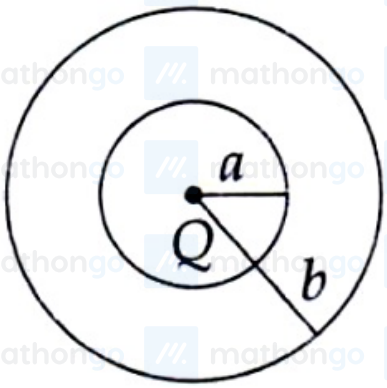
(1) $2f$ (2) f
(3) $\frac{f}{2}$ (4) $\frac{3f}{4}$

Q12. A uniform string of length 20 m is suspended from a rigid support. A short wave pulse is introduced at its lowest end. It starts moving up the string. The time taken to reach the support is
(Take, $g = 10\ m\ s^{-2}$)

(1) $2\sqrt{2}$ s (2) $\sqrt{2}$ s
(3) $2\pi\sqrt{2}$ s (4) 2 s

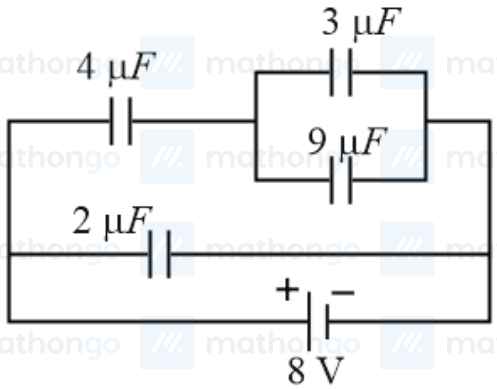
Q13. The region between two concentric spheres of radii 'a' and 'b', respectively (see figure), has volume charge density $\rho = \frac{A}{r}$, where A is a constant and r is the distance from the centre. At the centre of the spheres is a point charge Q. The value of A such that the electric field in the region between the spheres will be constant,

is:



(1) $\frac{2Q}{\pi(a^2-b^2)}$
(2) $\frac{2Q}{\pi a^2}$
(3) $\frac{Q}{2\pi a^2}$
(4) $\frac{Q}{2\pi(b^2-a^2)}$

Q14. A combination of capacitors is set up as shown in the figure. The magnitude of the electric field, due to a point charge Q (having a charge equal to the sum of the charges on the 4 μF and 9 μF capacitors), at a point distant 30 m from it, would equal:

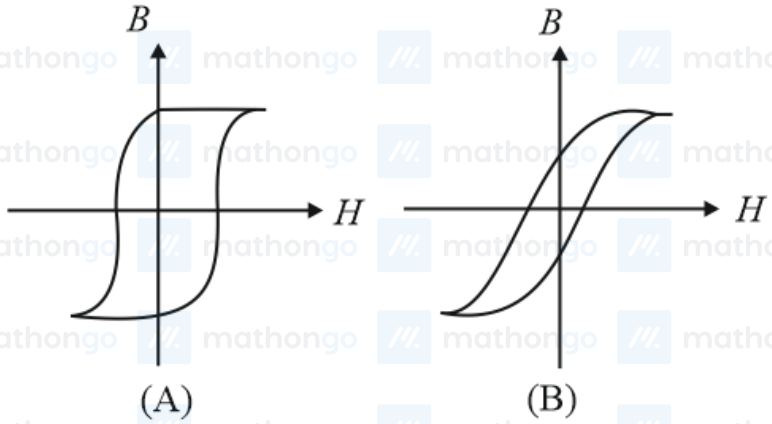


(1) 420 N/C
(2) 480 N/C
(3) 240 N/C
(4) 360 N/C

Q15. A galvanometer having a coil resistance of 100 Ω gives a full scale deflection, when a current of 1 mA is passed through it. The value of the resistance, which can convert this galvanometer into ammeter giving a full scale deflection for a current of 10 A, is:

(1) 0.1 Ω
(2) 3 Ω
(3) 0.01 Ω
(4) 2 Ω

Q16. Hysteresis loops for two magnetic materials A and B are given below:



These materials are used to make magnets for electric generators, transformer core and electromagnet core. Then it is proper to use:

(1) A for transformers and B for electric generators.

(2) B for electromagnets and transformers.

(3) A for electric generators and transformers.

(4) A for electromagnets and B for electric generators.

Q17. Two identical wires A and B, each of length l, carry the same current I. Wire A is bent into a circle of radius R and wire B is bent to form a square of side a. If B_{A} and B_{B} are the values of magnetic field at the centres of the circle and square respectively, then the ratio $\frac{B_{\mathrm{A}}}{B_{\mathrm{B}}}$ is

(1) $\frac{\pi^2}{16}$

(2) $\frac{\pi^2}{8\sqrt{2}}$

(3) $\frac{\pi^2}{8}$

(4) $\frac{\pi^2}{16\sqrt{2}}$

Q18. An arc lamp requires a direct current of 10 A at 80 V to function. If it is connected to a 220 V (rms), 50 Hz AC supply, the series inductor needed for it to work is close to:

(1) 0.044 H

(2) 0.065 H

(3) 80 H

(4) 0.08 H

Q19. Arrange the following electromagnetic radiations per quantum in the order of increasing energy:

A : Blue light

B : Yellow light

C : X-ray

D : Radiowave

(1) C, A, B, D

(2) B, A, D, C

(3) D, B, A, C

(4) A, B, D, C

Q20. An observer looks at a distant tree of height 10 m with a telescope of magnifying power of 20. To the observer, the tree appears as

(1) 20 times taller.

(2) 20 times nearer.

(3) 10 times taller.

(4) 10 times nearer.

Q21. In an experiment for determination of refractive index of glass of a prism by i v/s δ plot, it was found that a ray incident at angle 35^{o} , suffers a deviation of 40^{o} and that it emerges at angle 79^{o} . In that case which of the following is closest to the maximum possible value of the refractive index?

(1) 1.7 (2) 1.8

(3) 1.5 (4) 1.6

Q22. The box of a pin hole camera, of length L, has a hole of radius a. It is assumed that when the hole is illuminated by a parallel beam of light of wavelength λ the spread of the spot (obtained on the opposite wall of the camera) is the sum of its geometrical spread and the spread due to diffraction. The spot would then have its minimum size (say b_{min}) when:

(1) $a = \sqrt{\lambda L}$ and $b_{min} = \sqrt{4\lambda L}$ (2) $a = \frac{\lambda^2}{L}$ and $b_{min} = \sqrt{4\lambda L}$

(3) $a = \frac{\lambda^2}{L}$ and $b_{min} = \left(\frac{2\lambda^2}{L}\right)$ (4) $a = \sqrt{\lambda L}$ and $b_{min} = \left(\frac{2\lambda^2}{L}\right)$

Q23. Radiation of wavelength λ is incident on a photocell. The fastest emitted photoelectron has a speed v. If the wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted photoelectron will be

(1) $= v\left(\frac{4}{3}\right)^{\frac{1}{2}}$ (2) $= v\left(\frac{3}{4}\right)^{\frac{1}{2}}$

(3) $> v\left(\frac{4}{3}\right)^{\frac{1}{2}}$ (4) $< v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

Q24. Half-lives of two radioactive elements A and B are 20 minutes and 40 minutes, respectively. Initially, the samples have an equal number of nuclei. After 80 minutes, the ratio of decayed numbers of A and B nuclei will be:

(1) 1 : 4 (2) 5 : 4

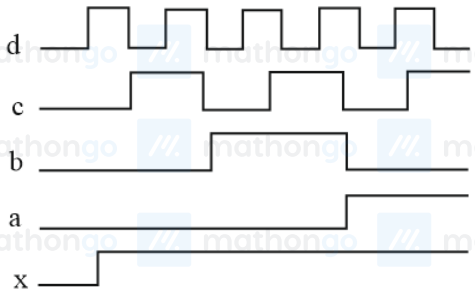
(3) 1 : 16 (4) 4 : 1

Q25. For a common emitter configuration, if α and β have their usual meanings, the correct relationship between α and β is:

(1) $\alpha = \frac{\beta}{1+\beta}$ (2) $\alpha = \frac{\beta^2}{1+\beta^2}$

(3) $\frac{1}{\alpha} = \frac{1}{\beta} - 1$ (4) $\alpha = \frac{\beta}{1-\beta}$

Q26. If a, b, c, d are inputs to a gate and x is its output, then, as per the following time graph, the gate is:



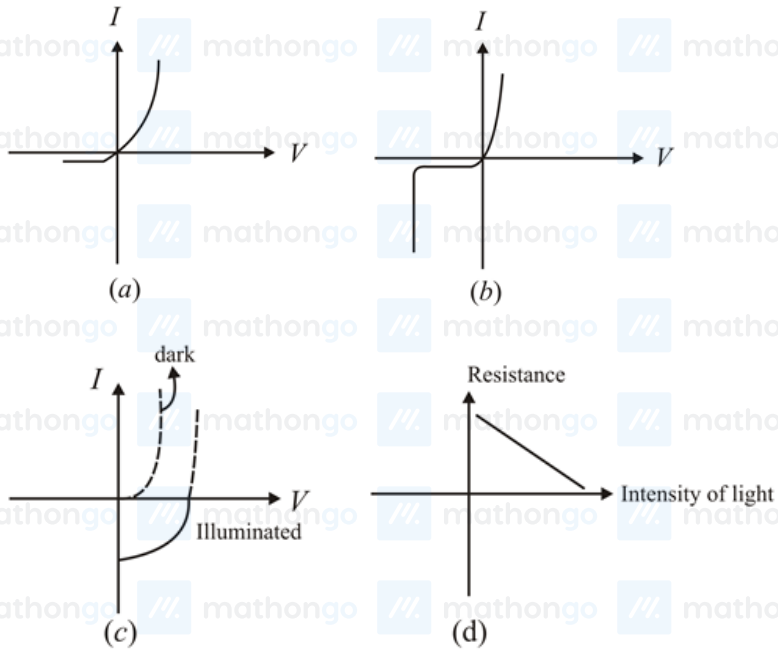
(1) OR (2) NAND

(3) NOT (4) AND

Q27. The temperature dependence of resistance of Cu and undoped Si in the temperature range $300 - 400$ K is best described by

(1) linear increase for Cu, exponential decrease for Si
(2) linear decrease for Cu, linear decrease for Si
(3) linear increase for Cu, linear increase for Si
(4) linear increase for Cu, exponential increase for Si

Q28. Identify the semiconductor devices whose characteristics are given below, in the order (a), (b), (c), (d):



(1) Solar cell, Light dependent resistance, Zener diode, Simple diode
(2) Zener diode, Solar cell, Simple diode, Light dependent resistance
(3) Simple diode, Zener diode, Solar cell, Light dependent resistance
(4) Zener diode, Simple diode, Light dependent resistance, Solar cell

Q29. Choose the correct statement:

(1) In frequency modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal.
(2) In frequency modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the frequency of the audio signal.
(3) In amplitude modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal.
(4) In amplitude modulation the frequency of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal.

Q30. A screw gauge with a pitch of 0.5 mm and a circular scale with 50 divisions is used to measure the thickness of a thin sheet of aluminium. Before starting the measurement, it is found that when the two jaws of the screw gauge are brought in contact, the 45^{th} division coincides with the main scale line and that the zero of the main scale is barely visible. What is the thickness of the sheet if the main scale reading is 0 .5 mm and the 25^{th} division coincides with the main scale line?

(1) 0.70 mm
(2) 0.50 mm
(3) 0.75 mm
(4) 0.80 mm

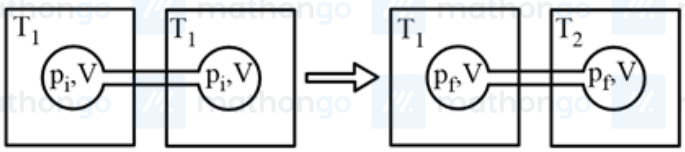
Q31. At 300 K and 1 atm, 15 mL of a gaseous hydrocarbon requires 375 mL air containing 20% O_2 by volume, for complete combustion. After combustion, the gases occupy 345 mL. Assuming that the water formed is in liquid form and the volumes were measured at the same temperature and pressure, the formula of the hydrocarbon is:
(Assume complete combustion of reactant)
(1) C_4H_8 (2) C_4H_{10}
(3) C_3H_6 (4) C_3H_8

Q32. A stream of electrons from a heat filament was passed between two charge plates kept at a potential difference V esu. If e and m are charge and mass of an electron, respectively, then the value of $\frac{h}{\lambda}$ (where λ is wavelength associated with the electron wave) is given by:
(1) $\sqrt{meV}$ (2) $\sqrt{2\,meV}$
(3) me V (4) 2 me V

Q33. Which of the following atoms has the highest first ionization energy?
(1) K (2) Sc
(3) Rb (4) Na

Q34. The species in which the N atom is a state of sp hybridization is:
(1) NO_3^- (2) NO_2
(3) NO_2^+ (4) NO_2^-

Q35. Two closed bulbs of equal volume (V) containing an ideal gas initially at pressure p_i and temperature T_1 are connected through a narrow tube of negligible volume, as shown in the figure below. The temperature of one of the bulbs is then raised to T_2. The final pressure P_f is:



(1) $2p_i\left(\frac{T_2}{T_1+T_2}\right)$ (2) $2p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$
(3) $p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$ (4) $2p_i\left(\frac{T_1}{T_1+T_2}\right)$

Q36. The heats of combustion of carbon and carbon monoxide are -393.5 and -283.5 kJ mol^{-1}, respectively. The heat of formation (in kJ) of carbon monoxide per mole is:
(1) -676.5 (2) -110
(3) 110.5 (4) 676.5

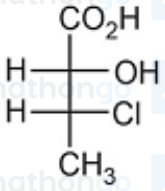
Q37. The equilibrium constant at 298 K for a reaction $A + B \rightleftharpoons C + D$ is 100. If the initial concentration of all the four species were1 M each, then the equilibrium concentration of D (in mol L^{-1}) will be:
(1) 1.818 (2) 1.182
(3) 0.182 (4) 0.818

Q38. Which of the following statements about water is FALSE?

(1) There is extensive intramolecular hydrogen bonding in the condensed phase.
(2) Ice formed by heavy water sinks in normal water.
(3) Water is oxidized to oxygen during photosynthesis
(4) Water can act both as an acid and as a base

Q39. The main oxides formed on combustion of Li, Na and K in excess of air are respectively:
(1) Li_2O_2, Na_2O_2 and KO_2
(2) Li_2O, Na_2O_2 and KO_2
(3) Li_2O, Na_2O and KO_2
(4) LiO_2, Na_2O_2 and K_2O

Q40. The absolute configuration of



is:
(1) (2S, 3S)
(2) (2R, 3R)
(3) (2R, 3S)
(4) (2S, 3R)

Q41. The distillation technique most suited for separating glycerol from spent - lye in the soap industry is:
(1) Steam distillation
(2) Distillation under reduced pressure
(3) Simple distillation
(4) Fractional distillation

Q42. The reaction of propene with HOCl ($Cl_2 + H_2O$) proceeds through the intermediate:
(1) $CH_3 - CH(OH) - CH_2^+$
(2) $CH_3 - CHCl - CH_2^+$
(3) $CH_3 - CH^+ - CH_2 - OH$
(4) $CH_3 - CH^+ - CH_2 - Cl$

Q43. The concentration of fluoride, lead, nitrate and iron in a water sample from an underground lake was found to be 1000 ppb, 40 ppb, 100 ppm and 0.2 ppm, respectively. This water is unsuitable for drinking due to high concentration of:
(1) Nitrate
(2) Iron
(3) Fluoride
(4) Lead

Q44. 18 g glucose ($C_6H_{12}O_6$) is added to 178.2 g water. The vapour pressure of water (in torr) for this aqueous solution is:
(1) 752.4
(2) 759.0
(3) 7.6
(4) 76.0

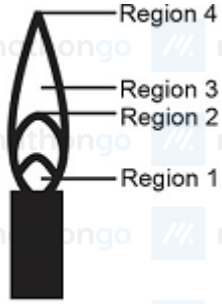
Q45. Galvanization is applying a coating of:
(1) Cu
(2) Zn
(3) Pb
(4) Cr

Q46. Decomposition of H_2O_2 follows a first order reaction. In fifty minutes the concentration of H_2O_2 decreases from 0.5 to 0.125 M in one such decomposition. When the concentration of H_2O_2 reaches 0.05 M , the rate of formation of O_2 will be:

(1) 2.66 $Lmin^{-1}$ at STP (2) 1.34×10^{-2} mol min^{-1}
(3) 6.93×10^{-2} mol min^{-1} (4) 6.93×10^{-4} mol min^{-1}

Q47. For a linear plot of $\log\left(\frac{x}{m}\right)$ versus $\log$ p in a Freundlich adsorption isotherm, which of the following statements is correct? (k and n are constants)
(1) Only $\frac{1}{n}$ appears as the slope. (2) $\log\left(\frac{1}{n}\right)$ appears as the intercept.
(3) Both k and $\frac{1}{n}$ appear in the slope term. (4) $\frac{1}{n}$ appears as the intercept.

Q48. The hottest region of Bunsen flame shown in the figure below is:



(1) Region 3 (2) Region 4
(3) Region 1 (4) Region 2

Q49. Which one of the following ores is best concentrated by froth flotation method?
(1) Galena (2) Malachite
(3) Magnetite (4) Siderite

Q50. The pair in which phosphorous atoms have a formal oxidation state of + 3 is:
(1) Orthophosphorous and hypophospheric acids (2) Pyrophosphorous and pyrophosphoric acids
(3) Orthophosphorous and pyrophosphorous acids (4) Pyrophosphorous and hypophosphoric acids

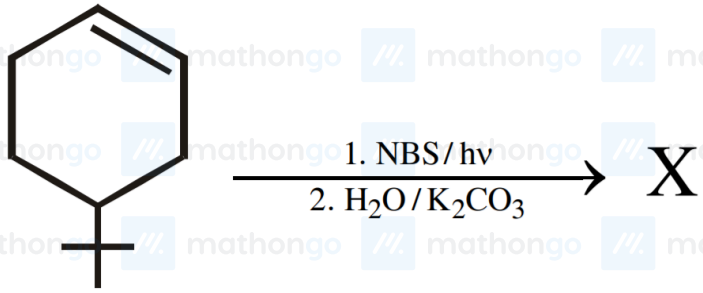
Q51. The reaction of zinc with dilute and concentrated nitric acid, respectively, produces:
(1) NO and N_2O (2) NO_2 and N_2O
(3) N_2O and NO_2 (4) NO_2 and NO

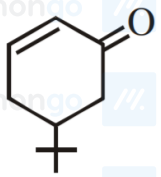
Q52. Find the metallic and ferromagnetic substance.
(1) VO_2 (2) MnO_2
(3) TiO_2 (4) CrO_2

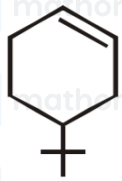
Q53. Which one of the following complexes shows optical isomerism? (en=ethylendiamine)
(1) trans $[Co(en)_2\ Cl_2]\ Cl$ (2) $[Co(NH_3)_4\ Cl_2]\ Cl$
(3) $[Co\ (NH_3)_3\ Cl_3]$ (4) cis $[Co(en)_2\ Cl_2]Cl$

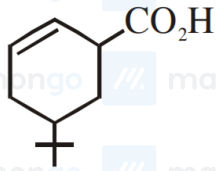
Q54. The pair having the same magnetic moment is:
$[At.\ No.\ : Cr = 24,\ Mn = 25,\ Fe = 26,\ Co = 27]$
(1) $[Mn\ (H_2O)_6]^{2+}$ and $[Cr(H_2O)_6]^{2+}$ (2) $[CoCl_4]^{2-}$ and $[Fe(H_2O)_6]^{2+}$
(3) $[Cr(H_2O)_6]^{2+}$ and $[CoCl_4]^{2-}$ (4) $[Cr(H_2O)_6]^{2+}$ and $[Fe(H_2O)_6]^{2+}$

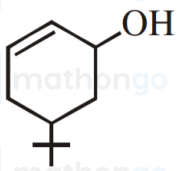
Q55. The product of the reaction give below is:



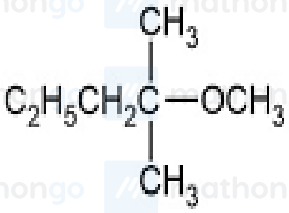
(1) 

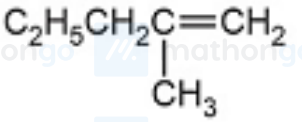
(2) 

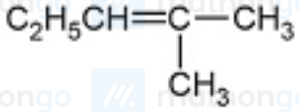
(3) 

(4) 

Q56. 2- chloro - 2 - methylpentane on reaction with sodium methoxide in methanol yields:

(i) 

(ii) 

(iii) 

(1) iii only
(2) i and ii
(3) i and iii
(4) All of these

Q57. In the Hoffmann bromamide degradation reaction, the number of moles of NaOH and Br_2 used per mole of amine produced are:

(1) Two moles of NaOH and two moles of Br_2
(2) Four moles of NaOH and one mole of Br_2
(3) One mole of NaOH and one mole of Br_2
(4) Four moles of NaOH and two moles of Br_2

Q58. Which of the following statements about low density polythene is FALSE?

(1) Its synthesis required dioxygen or a peroxide initiator as a catalyst
(2) It is used in the manufacture of buckets, dust - bins etc.
(3) Its synthesis requires high pressure
(4) It is a poor conductor of electricity

Q59. Which of the following is an anionic detergent?
(1) Cetyltrimethyl ammonium bromide
(2) Glyceryl oleate
(3) hexadecyltrimethyl ammonium bromide
(4) Sodium lauryl sulphate

Q60. Thiol group is present in:
(1) Cysteine
(2) Methionine
(3) Cytosine
(4) Cystine

Q61. The sum of all real values of x satisfying the equation $\left(x^2-5x+5\right)^{x^2+4x-60}=1$ is
(1) 6
(2) 5
(3) 3
(4) -4

Q62. A value of θ for which $\frac{2+3i\sin\theta}{1-2i\sin\theta}$ is purely imaginary, is
(1) $\sin^{-1}\left(\frac{\sqrt{3}}{4}\right)$
(2) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$
(3) $\frac{\pi}{3}$
(4) $\frac{\pi}{6}$

Q63. If all the words (with or without meaning) having five letters, formed using the letters of the word $SMALL$ and arranged as in a dictionary; then the position of the word $SMALL$ is
(1) 52^{nd}
(2) 58^{th}
(3) 46^{th}
(4) 59^{th}

Q64. If the 2^{nd}, 5^{th} and 9^{th} terms of a non-constant arithmetic progression are in geometric progression, then the common ratio of this geometric progression is
(1) 1
(2) $\frac{7}{4}$
(3) $\frac{8}{5}$
(4) $\frac{4}{3}$

Q65. If the sum of the first ten terms of the series $\left(1\frac{3}{5}\right)^2+\left(2\frac{2}{5}\right)^2+\left(3\frac{1}{5}\right)^2+4^2+\left(4\frac{4}{5}\right)^2+\ldots$, is $\frac{16}{5}m$, then m is equal to
(1) 100
(2) 99
(3) 102
(4) 101

Q66. If the number of terms in the expansion of $\left(1-\frac{2}{x}+\frac{4}{y^2}\right)^n$, $x,\ y\neq 0$, is 28, then the sum of the coefficients of all the terms in this expansion is
(1) 243
(2) 729
(3) 64
(4) 2187

Q67. If $0\ \leq x<2\pi$, then the number of real values of x, which satisfy the equation $\cos x+\cos 2x+\cos 3x+\cos 4x=0$, is
(1) 7
(2) 9
(3) 3
(4) 5

Q68. Two sides of a rhombus are along the lines, $x-y+1=0$ and $7x-y-5=0$. If its diagonals intersect at $(-1,\ -2)$, then which one of the following is a vertex of this rhombus ?

(1) $\left(\frac{1}{3},\ -\frac{8}{3}\right)$ (2) $\left(-\frac{10}{3},\ -\frac{7}{3}\right)$

(3) $(-3,\ -9)$ (4) $(-3,\ -8)$

Q69. The centres of those circles which touch the circle, $x^2+y^2-8x-8y-4=0$, externally and also touch the x - axis, lie on

(1) A hyperbola (2) A parabola

(3) A circle (4) An ellipse which is not a circle

Q70. If one of the diameters of the circle, given by the equation, $x^2+y^2-4x+6y-12=0$, is a chord of a circle S, whose centre is at $(-3,\ 2)$, then the radius of S is

(1) 5 (2) 10

(3) $5\sqrt{2}$ (4) $5\sqrt{3}$

Q71. Let P be the point on the parabola, $y^2=8x$ which is at a minimum distance from the center C of the circle $x^2+(y+6)^2=1$. Then the equation of the circle, passing through C and having its center at P is

(1) $x^2+y^2-\frac{x}{4}+2y-24=0$ (2) $x^2+y^2-4x+9y+18=0$

(3) $x^2+y^2-4x+8y+12=0$ (4) $x^2+y^2-x+4y-12=0$

Q72. The eccentricity of the hyperbola whose length of its conjugate axis is equal to half of the distance between its foci, is

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

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

Q73. $\lim\limits_{n\to\infty}\left(\frac{(n+1)\,(n+2)\ldots 3n}{n^{2n}}\right)^{\frac{1}{n}}$ is equal to

(1) $\frac{9}{e^2}$ (2) $3\log 3-2$

(3) $\frac{18}{e^4}$ (4) $\frac{27}{e^2}$

Q74. Let $P=\lim\limits_{x\to 0^+}\left(1+\tan^2\sqrt{x}\,\right)^{\frac{1}{2x}}$, then $\log P$ is equal to

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

(3) 2 (4) 1

Q75. The Boolean Expression $(p\wedge\sim q)\ \vee q\vee(\sim p\wedge q)$ is equivalent to

(1) $p\ \vee q$ (2) $p\vee\sim q$

(3) $\sim p\wedge q$ (4) $p\wedge q$

Q76. If the standard deviation of the numbers $2,\ 3,\ a$ and 11 is 3.5, then which of the following is true ?

(1) $3a^2-34a+91=0$. (2) $3a^2-23a+44=0$.

(3) $3a^2-26a+55=0$. (4) $3a^2-32a+84=0$.

Q77. A man is walking towards a vertical pillar in a straight path, at a uniform speed. At a certain point A on the path, he observes that the angle of elevation of the top of the pillar is 30°. After walking for 10 minutes from

A in the same direction, at a point B, he observes that the angle of elevation of the top of the pillar is 60°. Then the time taken (in minutes) by him, from B to reach the pillar, is

(1) 20 (2) 5
(3) 6 (4) 10

Q78. If $A = \begin{bmatrix} 5a & -b \\ 3 & 2 \end{bmatrix}$ and $A.adjA = A\,A^T$, then $5a + b$ is equal to

(1) 4 (2) 13
(3) -1 (4) 5

Q79. The system of linear equations

$x + \lambda y - z = 0$
$\lambda x - y - z = 0$
$x + y - \lambda z = 0$

has a non -trivial solution for

(1) Exactly two values of λ (2) Exactly three values of λ
(3) Infinitely many values of λ (4) Exactly one value of λ

Q80. If $f(x) + 2f\left(\frac{1}{x}\right) = 3x,\ x \neq 0$, and $S = \{x \in R : f(x) = f(-x)\}$, then S

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

Q81. For $x \in R$, $f(x) = |\log 2 - \sin x|$ and $g(x) = f(f(x))$, then

(1) $g'(0) = -\cos(\log 2)$ (2) g is differentiable at $x = 0$ and $g'(0) = -\sin(\log 2)$
(3) g is not differentiable at $x = 0$ (4) $g'(0) = \cos(\log 2)$

Q82. Consider $f(x) = \tan^{-1}\left(\sqrt{\frac{1+\sin x}{1-\sin x}}\right),\ x \in \left(0, \frac{\pi}{2}\right)$. A normal to $y = f(x)$ at $x = \frac{\pi}{6}$ also passes through the point

(1) $\left(\frac{\pi}{6},\ 0\right)$ (2) $\left(\frac{\pi}{4},\ 0\right)$
(3) $(0,\ 0)$ (4) $\left(0, \frac{2\pi}{3}\right)$

Q83. A wire of length 2 units is cut into two parts which are bent respectively to form a square of side $= x$ units and a circle of radius $= r$ units. If the sum of the areas of the square and the circle so formed is minimum, then

(1) $x = 2r$ (2) $2x = r$
(3) $2x = (\pi + 4)r$ (4) $(4 - \pi)x = \pi r$

Q84. The integral $\int \frac{2x^{12} + 5x^9}{\left(x^5 + x^3 + 1\right)^3} dx$, is equal to

(1) $\frac{x^5}{2\left(x^5 + x^3 + 1\right)^2} + c$ (2) $\frac{-x^{10}}{2\left(x^5 + x^3 + 1\right)^2} + c$
(3) $\frac{-x^5}{\left(x^5 + x^3 + 1\right)^2} + c$ (4) $\frac{x^{10}}{2\left(x^5 + x^3 + 1\right)^2} + c$

Q85. The area (in sq. units) of the region $\left\{(x,\ y) : y^2 \geq 2x \text{ and } x^2 + y^2 \leq 4x,\ x \geq 0,\ y \geq 0\right\}$ is

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

Q86. If a curve $y = f(x)$ passes through the point $(1, -1)$ and satisfies the differential equation, $y\,(1 + xy)dx = x\,dy$, then $f\left(-\frac{1}{2}\right)$ is equal to

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

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

Q87. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three unit vectors such that $\vec{a} \times \left(\vec{b} \times \vec{c}\right) = \frac{\sqrt{3}}{2}\left(\vec{b} + \vec{c}\right)$. If $\vec{b}$ is not parallel to $\vec{c}$, then the angle between $\vec{a}$ and $\vec{b}$ is

(1) $\frac{2\pi}{3}$ (2) $\frac{5\pi}{6}$

(3) $\frac{3\pi}{4}$ (4) $\frac{\pi}{2}$

Q88. If the line, $\frac{x-3}{2} = \frac{y+2}{-1} = \frac{z+4}{3}$ lies in the plane $lx + my - z = 9$, then $l^2 + m^2$ is equal to

(1) 5 (2) 2

(3) 26 (4) 18

Q89. The distance of the point $(1, -5, 9)$ from the plane $x - y + z = 5$ measured along the line $x = y = z$ is

(1) $\frac{10}{\sqrt{3}}$ (2) $\frac{20}{3}$

(3) $3\sqrt{10}$ (4) $10\sqrt{3}$

Q90. Let two fair six-faced dice A and B be thrown simultaneously. If E_1 is the event that die A shows up four, E_2 is the event that die B shows up two and E_3 is the event that the sum of numbers on both dice is odd, then which of the following statements is not true?

(1) E_1 and E_3 are independent (2) E_1, E_2 and E_3 are independent

(3) E_1 and E_2 are independent (4) E_2 and E_3 are independent

ANSWER KEYS

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