Q1. A vector $\overrightarrow{A}$ is rotated by a small angle $\Delta\theta$ radians $(\Delta\theta \ll 1)$ to get a new vector $\overrightarrow{B}$. In that case $\left|\overrightarrow{B}-\overrightarrow{A}\right|$ is :

(1) $\left|\overrightarrow{A}\right|\left[1-\frac{(\Delta\theta)^2}{2}\right]$ (2) 0

(3) $\left|\overrightarrow{A}\right| \Delta\theta$ (4) $\left|\overrightarrow{B}\right| \Delta\theta - \left|\overrightarrow{A}\right|$

Q2. A beaker contains a fluid of density $\rho\frac{kg}{m^3}$, specific heat $S\frac{J}{kg^oC}$ and viscosity η . The beaker is filled up to height h. To estimate the rate of heat transfer per unit area $\left(\frac{\dot{Q}}{A}\right)$ by convection when beaker is put on a hot plate, a student proposes that it should depend on η , $\left(\frac{S\Delta\theta}{h}\right)$ and $\left(\frac{1}{\rho g}\right)$ when $\Delta\theta$ (in^oC) is the difference in the temperature between the bottom and top of the fluid. In that situation the correct option for $\left(\frac{\dot{Q}}{A}\right)$ is:

(1) $\left(\frac{S\Delta\theta}{h}\right)\eta$ (2) $\eta\left(\frac{S\Delta\theta}{h}\right)\left(\frac{1}{\rho g}\right)$

(3) $\left(\frac{S\Delta\theta}{\eta h}\right)\left(\frac{1}{\rho g}\right)$ (4) $\frac{S\Delta\theta}{\eta h}$

Q3. If electronic charge e, electron mass m, speed of light in vacuum c and Planck's constant h are taken as fundamental quantities, the permeability of vacuum μ_0 can be expressed in units of:

(1) $\left(\frac{mc^2}{he^2}\right)$ (2) $\left(\frac{h}{me^2}\right)$

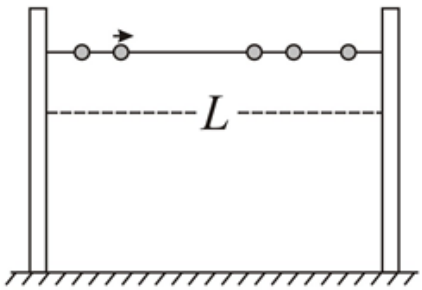
(3) $\left(\frac{hc}{me^2}\right)$ (4) $\left(\frac{h}{ce^2}\right)$

Q4. From the top of a 64 metres high tower, a stone is thrown upwards vertically with the velocity of 48 $\mathrm{m/s}$. The greatest height (in metres) attained by the stone, assuming the value of the gravitational acceleration $g = 32\ \mathrm{m/s^2}$, is:

(1) 112 (2) 88

(3) 128 (4) 100

Q5. A large number (n) of identical beads, each of mass m and radius r are strung on a thin smooth rigid horizontal rod of length $L(L \gg r)$ and are at rest at random positions. The rod is mounted between two rigid supports (see figure). If one of the beads is now given a speed v, the average force experienced by each support after a long time is (assume all collisions are elastic):



(1) $\frac{mv^2}{L-nr}$ (2) $\frac{mv^2}{L-2nr}$

(3) $\frac{mv^2}{2(L-nr)}$ (4) $Zero$

Q6. A particle is moving in a circle of radius r under the action of a force $F = \alpha r^2$ which is directed towards centre of the circle. Total mechanical energy (kinetic energy + potential energy) of the particle is (take potential energy $= 0$ for $r = 0$):

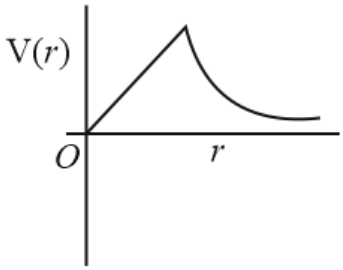
(1) $\frac{5}{6}\alpha r^3$ (2) αr^3
(3) $\frac{1}{2}\alpha r^3$ (4) $\frac{4}{3}\alpha r^3$

Q7. A uniform thin rod AB of length L has linear mass density $\mu(x) = a + \frac{bx}{L}$, where x is measured from A. If the CM of the rod lies at a distance of $\left(\frac{7}{12}L\right)$ from A, then a and b are related as:
(1) $2a = b$ (2) $a = 2b$
(3) $a = b$ (4) $3a = 2b$

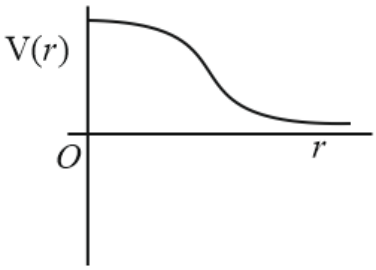
Q8. A particle of mass 2 kg is on a smooth horizontal table and moves in a circular path of radius 0.6 m. The height of the table from the ground is 0.8 m. If the angular speed of the particle is 12 rad s^{-1}, the magnitude of its angular momentum about a point on the ground right under the center of the circle is:
(1) 14.4 kg $\text{m}^2\,\text{s}^{-1}$ (2) 11.52 kg $\text{m}^2\,\text{s}^{-1}$
(3) 20.16 kg $\text{m}^2\,\text{s}^{-1}$ (4) 8.64 kg $\text{m}^2\,\text{s}^{-1}$

Q9. Which of the following most closely depicts the correct variation of the gravitation potential, $V(r)$ with distance r due to a large planet of radius R and uniform mass density? (figures are not drawn to scale)

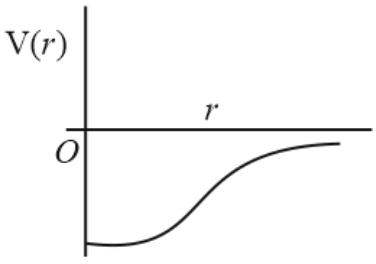
(1)



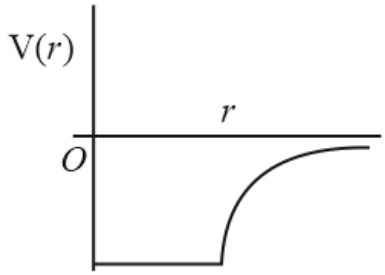
(2)



(3)



(4)



Q10. An experiment takes 10 min to raise the temperature of water in a container from 0°C to 100°C and another 55 min to convert it totally into steam by a heater supplying heat at a uniform rate. Neglecting the specific heat of the container and taking specific heat of the water to be 1 cal $(\text{g}^\circ\text{C})^{-1}$, the heat of vaporization according to this experiment will come out to be:
(1) 530 cal g^{-1} (2) 550 cal g^{-1}
(3) 540 cal g^{-1} (4) 560 cal g^{-1}

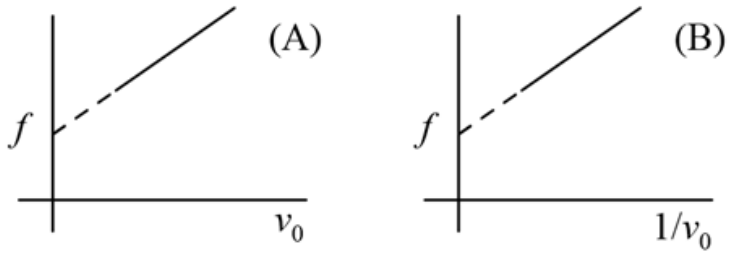
Q11. Using equipartition of energy, the specific heat (in J kg^{-1} K^{-1}) of Aluminium at high temperature can be estimated to be (atomic weight of Aluminium $= 27$)
(1) 25 (2) 1850
(3) 410 (4) 925

Q12. A pendulum with the time period of 1 s is losing energy due to damping. At a certain time, its energy is 45 J. If after completing 15 oscillations its energy has become 15 J, then its damping constant (in s^{-1}) will be

(1) $\frac{1}{2}$ (2) $\frac{1}{15}\ln 3$
(3) $\frac{1}{30}\ln 3$ (4) 2

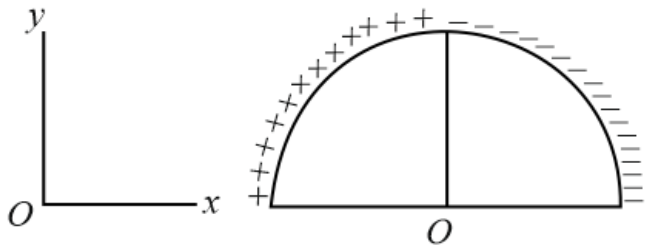
Q13. A cylindrical block of wood (density = 650 kg m^{-3}), of base area 30 cm^2 and height 54 cm, floats in a liquid of density 900 kg m^{-3}. The block is depressed slightly and then released. The time period of the resulting oscillations of the block would be equal to that of a simple pendulum of length (nearly) :
(1) 52 cm (2) 26 cm
(3) 39 cm (4) 65 cm

Q14. A source of sound emits sound waves at frequency f_0 . It is moving towards an observer with fixed speed v_s $(v_s < \text{v})$, where v is the speed of sound in air). If the observer were to move towards the source with speed v_0 , one of the following two graphs (A and B) will give the correct variation of the frequency f heard by the observer as v_0 is changed.



The variation of f with v_0 is given correctly by:
(1) Graph A with slope $= \frac{f_0}{(v-v_s)}$ (2) Graph A with slope $= \frac{f_0}{(v+v_s)}$
(3) Graph B with slope $= \frac{f_0}{(v-v_s)}$ (4) Graph B with slope $= \frac{f_0}{(v+v_s)}$

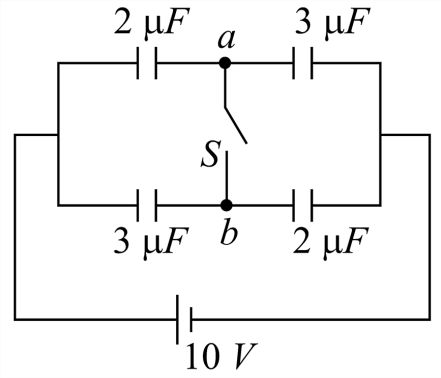
Q15. A wire of length $L = 20$ cm is bent into a semi-circular arc and the two equal halves of the arc are uniformly charged with charges $+Q$ and $-Q$ as shown in the figure. The magnitude of the charge on each half is $|Q| = 10^3\varepsilon_0$, where ε_0 is the permittivity of free the space. The net electric field at the centre O is



(1) $\left(25 \times 10^3\right)\hat{\text{i}}$ N C^{-1} (2) $\left(50 \times 10^3\right)\hat{\text{i}}$ N C^{-1}
(3) $\left(25 \times 10^3\right)\hat{\text{j}}$ N C^{-1} (4) $\left(50 \times 10^3\right)\hat{\text{j}}$ N C^{-1}

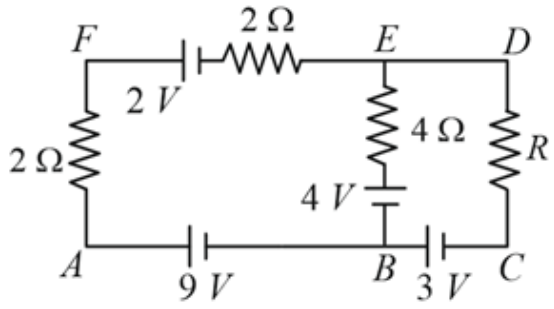
Q16. An electric field $\vec{E} = \left(25\,\hat{\text{i}} + 30\,\hat{\text{j}}\right)$ N C^{-1} exists in a region of space. If the potential at the origin is taken to be zero then the potential at $x = 2$ m, $y = 2$ m is:
(1) -110 J C^{-1} (2) -140 J C^{-1}
(3) -130 J C^{-1} (4) -120 J C^{-1}

Q17. In the figure is shown a system of four capacitors connected across a 10 V battery. The charge that will flow from switch S when it is closed is:



(1) Zero
(2) 20 μC from a to b
(3) 5 μC from b to a
(4) 5 μC from a to b

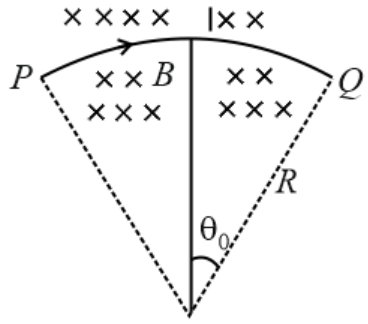
Q18. In the electric network shown, when no current flows through the 4 Ω resistor in the arm EB, the potential difference between the points A and D will be:



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

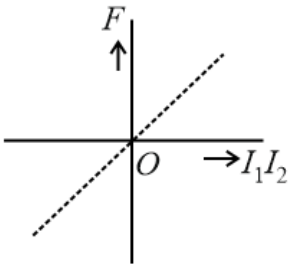
Q19. A short bar magnet is placed in the magnetic meridian of the earth with North Pole pointing north. Neutral points are found at a distance of 30 cm from the magnet on the East-West line, drawn through the middle point of the magnet. The magnetic moment of the magnet in Am^2 is close to:
(Given $\frac{\mu_0}{4\pi} = 10^{-7}$ in SI units and B_H = Horizontal component of earth's magnetic field $= 3.6 \times 10^{-5}$ Tesla.)
(1) 4.9
(2) 14.6
(3) 19.4
(4) 9.7

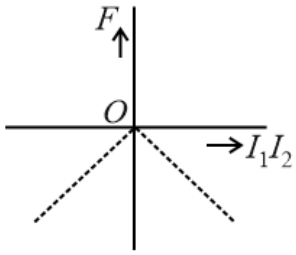
Q20. A wire carrying current I is tied between points P and Q and is in the shape of a circular arc of radius R due to a uniform magnetic field B (perpendicular to the plane of the paper, as shown in the figure) in the vicinity of the wire. If the wire subtends an angle $2\theta_o$ at the center of the circle (of which it forms an arch) then the tension in the wire is:

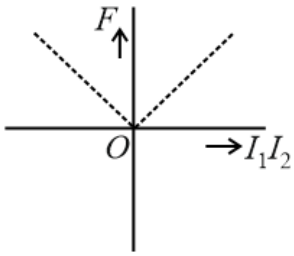


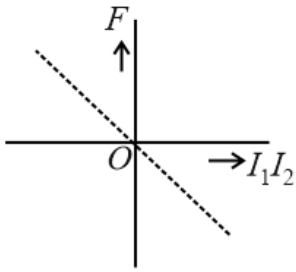
(1) IBR (2) $\frac{IBR}{sin\theta_0}$
(3) $\frac{IBR}{2sin\theta_0}$ (4) $\frac{IBR\theta_0}{sin\theta_0}$

Q21. Two long straight parallel wires, carrying (adjustable) currents I_1 and I_2 , are kept at a distance d apart. If the force F between the two wires is taken as 'positive' when the wires repel each other and 'negative' when the wires attract each other, the graph showing the dependence of F, on the product I_1I_2 , would be:

(1)


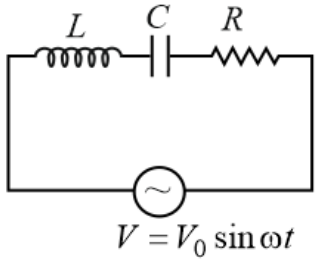
(2)


(3)


(4)


Q22. The AC voltage across a resistance can be measured using a:
(1) Moving magnet galvanometer (2) Moving coil galvanometer
(3) Hot wire voltmeter (4) Potentiometer

Q23. For the LCR circuit, shown here, the current is observed to lead the applied voltage. An additional capacitor C' , when joined with the capacitor C present in the circuit, makes the power factor of the circuit unity. The capacitor C' , must have been connected in:

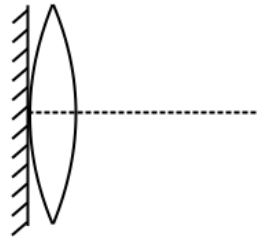


(1) Parallel with C and has a magnitude $\frac{1-\omega^2LC}{\omega^2L}$ (2) Series with C and has a magnitude $\frac{1-\omega^2LC}{\omega^2L}$
(3) Series with C and has a magnitude $\frac{C}{(\omega^2LC-1)}$ (4) Parallel with C and has a magnitude $\frac{C}{(\omega^2LC-1)}$

Q24. For plane electromagnetic waves propagating in the $+z$-direction, which one of the following combinations gives the correct possible direction for $\overrightarrow{E}$ and $\overrightarrow{B}$ field respectively?
(1) $\left(\hat{\mathrm{i}}+2\hat{\mathrm{j}}\right)$ and $\left(2\hat{\mathrm{i}}-\mathrm{j}\right)$ (2) $\left(-2\hat{\mathrm{i}}-3\hat{\mathrm{j}}\right)$ and $\left(3\hat{\mathrm{i}}-2\hat{\mathrm{j}}\right)$
(3) $\left(2\hat{\mathrm{i}}+3\hat{\mathrm{j}}\right)$ and $\left(\hat{\mathrm{i}}+2\hat{\mathrm{j}}\right)$ (4) $\left(3\hat{\mathrm{i}}+4\hat{\mathrm{j}}\right)$ and $\left(4\hat{\mathrm{i}}-3\hat{\mathrm{j}}\right)$

Q25. A thin convex lens of focal length f is put on a plane mirror as shown in the figure. When an object is kept at a distance a from the lens-mirror combination, its image is formed at a distance $\frac{a}{3}$ in front of the combination.

The value of a is:



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

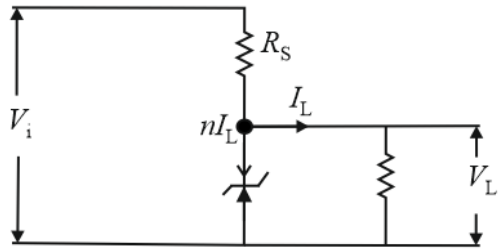
Q26. In a Young's double slit experiment with light of wavelength λ, the separation of slits is d and distance of screen is D such that $D \gg d \gg \lambda$. If the Fringe width is β , the distance from point of maximum intensity to the point where intensity falls to half of the maximum intensity on either side is:
(1) $\frac{\beta}{4}$ (2) $\frac{\beta}{3}$
(3) $\frac{\beta}{6}$ (4) $\frac{\beta}{2}$

Q27. Unpolarized light of intensity I_0 is incident on surface of a block of glass at Brewster's angle. In that case, which one of the following statements is true?
(1) transmitted light is partially polarized with intensity $\frac{I_0}{2}$ (2) transmitted light is completely polarized with intensity less than $\frac{I_0}{2}$
(3) reflected light is partially polarized with intensity $\frac{I_0}{2}$ (4) reflected light is completely polarized with intensity less than $\frac{I_0}{2}$

Q28. The de-Broglie wavelength associated with the electron in the $n = 4$ level is:
(1) Half of the de-Broglie wavelength of the electron in the ground state (2) Four times the de-Broglie wavelength of the electron in the ground state
(3) $\frac{1}{4}th$ of the de-Broglie wavelength of the electron in the ground state (4) Two times the de-Broglie wavelength of the electron in the ground state

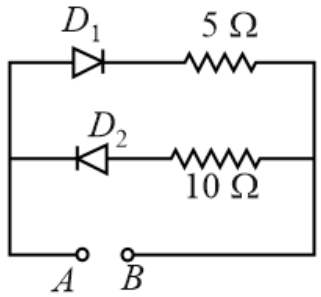
Q29. Let N_β be the number of β particle emitted by 1 gram of Na^{24} radioactive nuclei having a half life of 15 h. In 7.5 h, the number N_β is close to $\left[N_A = 6.023 \times 10^{23} \text{ mole}^{-1}\right]$
(1) 1.75×10^{22} (2) 6.2×10^{21}
(3) 7.5×10^{21} (4) 1.25×10^{22}

Q30. The value of the resistor, R_S, needed in the DC voltage regulator circuit shown here, equals:



(1) $\frac{(V_i+V_L)}{(n+1)I_L}$ (2) $\frac{(V_i-V_L)}{n\,I_L}$
(3) $\frac{(V_i+V_L)}{n\,I_L}$ (4) $\frac{(V_i-V_L)}{(n+1)I_L}$

Q31. A 2 V battery is connected across AB as shown in the figure. The value of the current supplied by the battery when in first case battery's positive terminal is connected to A and in second case when positive terminal of battery is connected to B will respectively be:



(1) 0.2 A and 0.1 A
(2) 0.1 A and 0.2 A
(3) 0.2 A and 0.4 A
(4) 0.4 A and 0.2 A

Q32. In the following reaction:

$A + 2B + 3C \rightleftharpoons AB_2C_3$

6.0 g of A, 6.0×10^{23} atoms of B and 0.036 mol of C reacted and formed 4.8 g of compound AB_2C_3. If the atomic mass of A and C are 60 and 80 amu, respectively. What is the atomic mass of B in amu? (Avogadro number$= 6 \times 10^{23}$)

(1) 40 amu
(2) 60 amu
(3) 70 amu
(4) 50 amu

Q33. An element X shows $+3$, oxidation state in its compounds. Out of the four compounds given below, choose the incorrect formula for the element X.

(1) X_2O_3
(2) $X_2(SO_4)_3$
(3) XPO_4
(4) X_2Cl_3

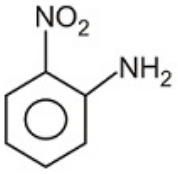
Q34. At temperature T, the average kinetic energy of any particle is $\frac{3}{2}$kT. The de Broglie wavelength follows the order:

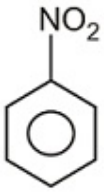
(1) Visible photon>thermal electron>thermal neutron.
(2) Thermal neutron>visible photon>thermal electron.
(3) Thermal neutron>thermal electron>visible photon.
(4) Visible photon>thermal neutron>thermal electron.

Q35. Molecule AB has a bond length of 1.617 Å and a dipole moment of 0.38 D. The fractional charge on each atom(absolute magnitude) is: $\left(e_0 = 4.802 \times 10^{-10} \text{ esu}\right)$

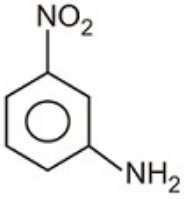
(1) 0.5
(2) 0.05
(3) 0
(4) 1.0

Q36. Which compounds exhibits maximum dipole moment among the following?

(1) 

(2) 

(3) 

(4) 

Q37. When does a gas deviate the most from its ideal behavior?

(1) At low pressure and high temperature
(2) At high pressure and high temperature
(3) At low pressure and low temperature
(4) At high pressure and low temperature

Q38. The increase of pressure on ice $\rightleftharpoons$ water system at constant temperature will lead to:

(1) A decrease in the entropy of the system
(2) An increase in the Gibbs energy of the system
(3) A shift of the equilibrium in the forward direction
(4) No effect on the equilibrium

Q39. Which physical property of di-hydrogen is wrong?

(1) Tasteless gas
(2) Odourless gas
(3) Colourless gas
(4) Non-inflammable gas

Q40. Which of the alkaline earth metal halides given below is essentially covalent in nature?

(1) $BeCl_2$
(2) $MgCl_2$
(3) $SrCl_2$
(4) $CaCl_2$

Q41. The number of structural isomers for C_6H_{14} is:

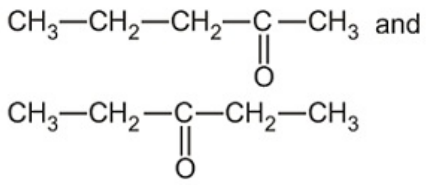
(1) 4
(2) 5
(3) 6
(4) 3

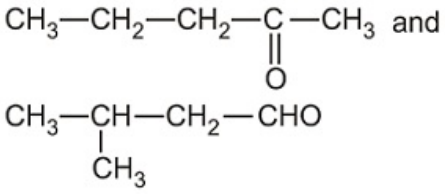
Q42. Match the organic compounds in column - I with the Lassaigne's test result in column - II appropriately:

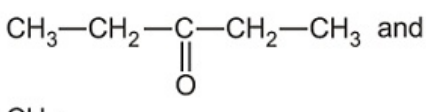
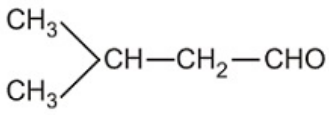
Column – I	**Column - II**
A. Aniline	**i.** Red colour with $FeCl_3$
B. Benzene sulfonic acid	**ii.** Violet color with sodium nitroprusside
C. Thiourea	**iii.** Blue color with and acidic solution of $FeSO_4$

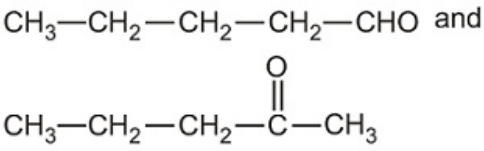
(1) A - ii ; B - iii ; C - i
(2) A - iii ; B - ii ; C - i
(3) A - ii ; B - i ; C - iii
(4) A - iii ; B - i ; C - ii

Q43. Which of the following pairs of compounds are positional isomers?

(1)  and

(2) 

(3)  and 

(4) 

Q44. Addition of phosphate fertilizers to water bodies causes:

(1) Deposition of calcium phosphate
(2) Enhanced growth of algae
(3) Increase in fish population
(4) Increase in amount of dissolved oxygen in water

Q45. Determination of the molar mass of acetic acid in benzene using freezing point depression is affected by:

(1) Complex formation
(2) Association
(3) Partial ionization
(4) Dissociation

Q46. At 298 K, the standard reduction potentials are 1.51 V for $MnO_4^- \mid Mn^{2+}$, 1.36 V for $Cl_2|Cl^-$, 1.07 V for $Br_2|Br^-$, 0.54 V for $I_2|I^-$. At pH $= 3$, permanganate is expected to oxidize: $\left(\frac{RT}{F} = 0.059\right)$

(1) Cl^- and Br^-
(2) Br^- and I^-
(3) I^- only
(4) Cl^- , Br^- and I^-

Q47. $A + 2B \rightarrow C$, the rate equation for the reaction is given as

Rate $= k\,[A]\,[B]$

If the concentration of A is kept the same but that of B is doubled what will happen to the rate itself?

(1) Doubled
(2) Halved
(3) The same
(4) Quadrupled

Q48. For the equilibrium, $A(g) \rightleftharpoons B(g)$, ΔH is -40 kJ / mol . If the ratio of the activation energies of the forward (E_f) and reverse (E_b) reactions is $\frac{2}{3}$ then:

(1) $E_f = 30$ kJ / mol, $E_b = 70$ kJ / mol
(2) $E_f = 70$ kJ / mol, $E_b = 30$ kJ / mol
(3) $E_f = 80$ kJ / mol, $E_b = 120$ kJ / mol
(4) $E_f = 60$ kJ / mol,$E_b = 100$ kJ / mol

Q49. Under ambient conditions, which among the following surfactants will form micelles in aqueous solution at lowest molar concentration?

(1) $CH_3(CH_2)_{11}\overset{\oplus}{N}(CH_3)_3\,Br^-$
(2) $CH_3 - (CH_2)_{13} - OSO_3^-\,Na^+$
(3) $CH_3(CH_2)_{15}\overset{\oplus}{N}(CH_3)_3\,\overset{\ominus}{Br}$
(4) CH_3—$(CH_2)_8$—$COO^{\ominus}\,Na^+$

Q50. Calamine is an ore of:

(1) Iron
(2) Copper
(3) Aluminium
(4) Zinc

Q51. Chlorine water on standing loses its color and forms:

(1) $HOCl$ and $HOCl_2$ (2) HCl only
(3) HCl and $HClO_2$ (4) HCl and $HOCl$

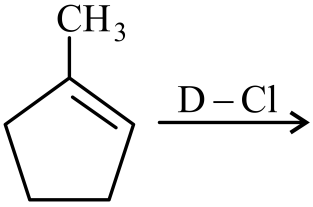
Q52. Which of the following compounds has a $P-P$ Bond?
(1) $(HPO_3)_3$ (2) $H_4P_2O_6$
(3) $H_4P_2O_7$ (4) $H_4P_2O_5$

Q53. Which of the following statements is/are false?
(1) $Na_2Cr_2O_7$ is more soluble than $K_2Cr_2O_7$. (2) CrO_4^{2-} is tetrahedral in shape.
(3) $Na_2Cr_2O_7$ is the primary standard in volumetry. (4) $Cr_2O_7^{2-}$ has a $Cr-O-Cr$ bond.

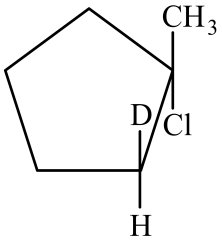
Q54. Which of the following complex ions has electrons that are symmetrically filled in both t_{2g} and e_g orbitals?
(1) $[Co(NH_3)_6]^{2+}$ (2) $[Mn(CN)_6]^{4-}$
(3) $[CoF_6]^{3-}$ (4) $[FeF_6]^{3-}$

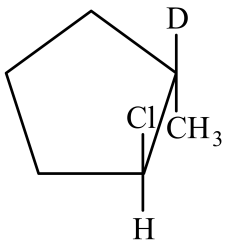
Q55. When concentrated HCl is added to aqueous solution of $CoCl_2$, its colour changes from reddish pink to deep blue. Which complex ion gives blue colour in reaction?
(1) $[CoCl_6]^{4-}$ (2) $[CoCl_6]^{3-}$
(3) $[Co(H_2O)_6]^{2+}$ (4) $[CoCl_4]^{2-}$

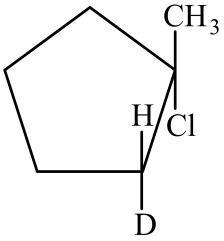
Q56. What is the major product expected from the following reaction?

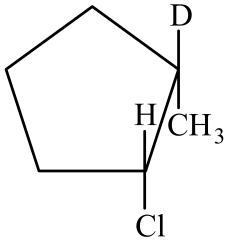


Where D is an isotope of hydrogen.

(1) 

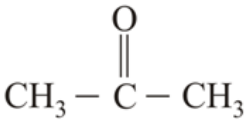
(2) 

(3) 

(4) 

Q57. In the reaction sequence
$2CH_3CHO \xrightarrow{OH^-} A \xrightarrow{\Delta} B$; the product B is:

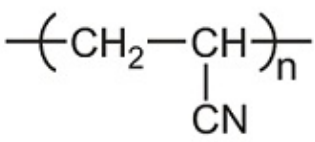
(1) $CH_3 - CH = CH - CHO$

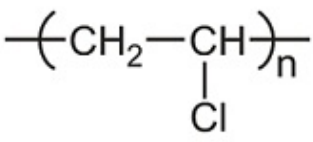
(2) 

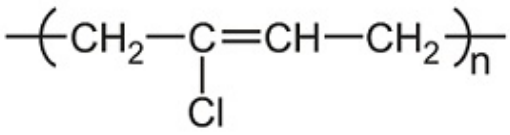
(3) $CH_3 - CH_2 - CH_2 - CH_3$

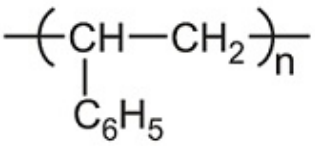
(4) $CH_3 - CH_2 - CH_2 - CH_2 - OH$

Q58. Which one of the following structures represents the neoprene polymer?

(1) 

(2) 

(3) 

(4) 

Q59. Which artificial sweetener contains chlorine?

(1) Sucralose

(2) Alitame

(3) Saccharin

(4) Aspartame

Q60. Accumulation of which of the following molecules in the muscles occurs as a result of vigorous exercise?

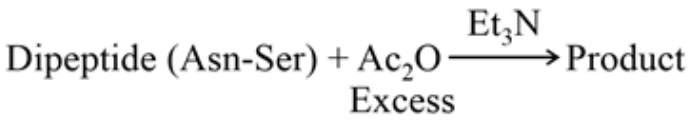
(1) Glycogen

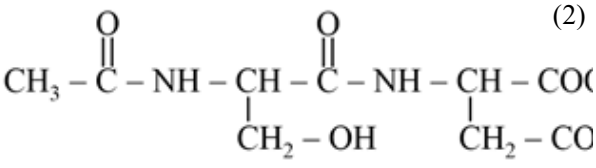
(2) Pyruvic acid

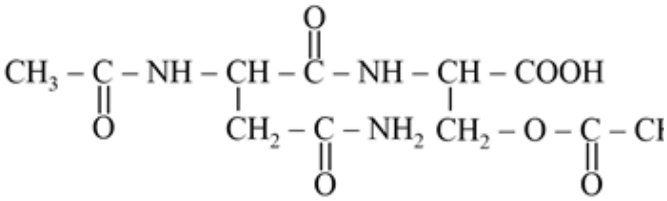
(3) Glucose

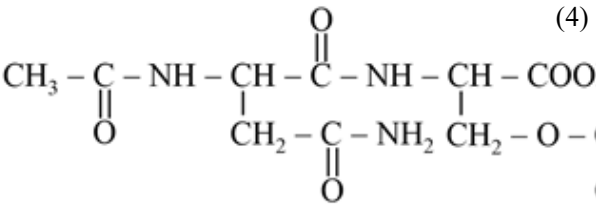
(4) L-lactic acid

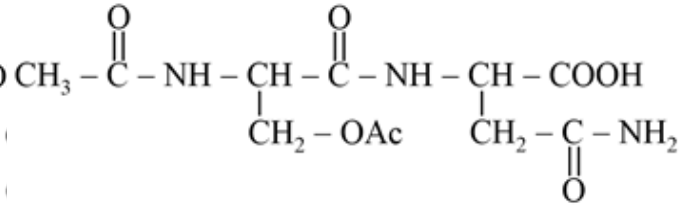
Q61.



(1) 

(2) 

(3) 

(4) 

Q62. If the two roots of the equation, $(a-1)\left(x^4+x^2+1\right)+(a+1)\left(x^2+x+1\right)^2=0$ are real and distinct, then the set of all values of a is equal to

(1) $\left(0, \frac{1}{2}\right)$

(2) $\left(-\frac{1}{2}, 0\right) \cup \left(0, \frac{1}{2}\right)$

(3) $(-\infty, -2) \cup (2, \infty)$

(4) $\left(-\frac{1}{2}, 0\right)$

Q63. If z is a non-real complex number, then the minimum value of $\frac{Im\, z^5}{(Im\, z)^5}$ is (Where $Im\, z$ = Imaginary part of z)

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

Q64. Let $A = \{x_1, x_2, \ldots, x_7\}$ and $B = \{y_1, y_2, y_3\}$ be two sets containing seven and three distinct elements respectively. Then the total number of functions $f : A \to B$ that are onto, if there exist exactly three elements x in A such that $f(x) = y_2$, is equal to:
(1) $12 \cdot {}^7C_2$ (2) $16 \cdot {}^7C_3$
(3) $14 \cdot {}^7C_3$ (4) $14 \cdot {}^7C_2$

Q65. If in a regular polygon the number of diagonals is 54, then the number of sides of this polygon is:
(1) 12 (2) 10
(3) 6 (4) 9

Q66. The sum of the 3^{rd} and the 4^{th} terms of a G. P. is 60 and the product of its first three terms is 1000. If the first term of this G. P. is positive, then its 7^{th} term is:
(1) 320 (2) 640
(3) 2430 (4) 7290

Q67. If $\sum_{n=1}^{5} \frac{1}{n(n+1)(n+2)(n+3)} = \frac{k}{3}$, then k is equal to:
(1) $\frac{55}{336}$ (2) $\frac{17}{105}$
(3) $\frac{19}{112}$ (4) $\frac{1}{6}$

Q68. The term independent of x in the binomial expansion of $\left(1 - \frac{1}{x} + 3x^5\right)\left(2x^2 - \frac{1}{x}\right)^8$ is
(1) -496 (2) -400
(3) 496 (4) 400

Q69. If $\cos\alpha + \cos\beta = \frac{3}{2}$ and $\sin\alpha + \sin\beta = \frac{1}{2}$ and θ is the arithmetic mean of α & β, then $\sin 2\theta + \cos 2\theta$ is equal to:
(1) $\frac{3}{5}$ (2) $\frac{7}{5}$
(3) $\frac{4}{5}$ (4) $\frac{8}{5}$

Q70. A straight line L through the point $(3, -2)$ is inclined at an angle of 60° to the line $\sqrt{3}x + y = 1$. If L also intersects the X-axis, then the equation of L is:
(1) $y + \sqrt{3}\,x + 2 - 3\sqrt{3} = 0$ (2) $\sqrt{3}\,y - x + 3 + 2\sqrt{3} = 0$
(3) $\sqrt{3}\,y + x - 3 + 2\sqrt{3} = 0$ (4) $y - \sqrt{3}x + 2 + 3\sqrt{3} = 0$

Q71. If a circle passing through the point $(-1, 0)$ touches y-axis at $(0, 2)$, then the x-intercept of the circle is
(1) $\frac{5}{2}$ (2) 5
(3) $\frac{3}{2}$ (4) 3

Q72. If the incentre of an equilateral triangle is $(1, 1)$ and the equation of its one side is $3x + 4y + 3 = 0$, then the equation of the circumcircle of this triangle is:
(1) $x^2 + y^2 - 2x - 2y - 2 = 0$ (2) $x^2 + y^2 - 2x - 2y + 2 = 0$
(3) $x^2 + y^2 - 2x - 2y - 7 = 0$ (4) $x^2 + y^2 - 2x - 2y - 14 = 0$

Q73. If PQ be a double ordinate of the parabola, $y^2 = -4x$, where P lies in the second quadrant. If R divides PQ in the ratio $2 : 1$, then the locus of R is:

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

Q74. If the distance between the foci of an ellipse is half the length of its latus rectum, then the eccentricity of the ellipse is:
(1) $\frac{1}{2}$ (2) $\sqrt{2}-1$
(3) $\frac{\sqrt{2}-1}{2}$ (4) $\frac{2\sqrt{2}-1}{2}$

Q75. Consider the following statements:
P: Suman is brilliant
Q: Suman is rich
R: Suman is honest
The negation of the statement, "Suman is brilliant and dishonest if and only if Suman is rich" can be equivalently expressed as
(1) $\sim Q \leftrightarrow \sim P \vee R$ (2) $\sim Q \leftrightarrow P \vee \sim R$
(3) $\sim Q \leftrightarrow P \wedge \sim R$ (4) $\sim Q \leftrightarrow \sim P \wedge R$

Q76. Let 10 vertical poles standing at equal distances on a straight line, subtend the same angle of elevation α at a point O on this line and all the poles are on the same side of O. If the height of the longest pole is h and the distance of the foot of the smallest pole from O is a; then the distance between two consecutive poles, is
(1) $\frac{h\sin\alpha+a\cos\alpha}{9\cos\alpha}$ (2) $\frac{h\cos\alpha-a\sin\alpha}{9\sin\alpha}$
(3) $\frac{h\sin\alpha+a\cos\alpha}{9\sin\alpha}$ (4) $\frac{h\cos\alpha-a\sin\alpha}{9\cos\alpha}$

Q77. If A is a 3×3 matrix such that $|5\ adjA| = 5$, then $|A|$ is equal to
(1) $\pm\frac{1}{25}$ (2) ± 5
(3) $\pm\frac{1}{5}$ (4) ± 1

Q78. If $\begin{vmatrix} x^2+x & x+1 & x-2 \\ 2x^2+3x-1 & 3x & 3x-3 \\ x^2+2x+3 & 2x-1 & 2x-1 \end{vmatrix} = ax - 12$, then a is equal to:
(1) -24 (2) 24
(3) -12 (4) 12

Q79. Let k be a non - zero real number. If $f(x) = \begin{cases} \frac{(e^x-1)^2}{\sin\left(\frac{x}{k}\right)\log\left(1+\frac{x}{4}\right)}, & x \neq 0 \\ 12 \quad , & x = 0 \end{cases}$ is a continuous function at $x = 0$, then the value of k is
(1) 2 (2) 4
(3) 3 (4) 1

Q80. The equation of a normal to the curve, $\sin y = x\sin\left(\frac{\pi}{3}+y\right)$ at $x = 0$, is:
(1) $2x - \sqrt{3}\,y = 0$ (2) $2y - \sqrt{3}\,x = 0$
(3) $2y + \sqrt{3}\,x = 0$ (4) $2x + \sqrt{3}\,y = 0$

Q81. Let k and K be the minimum and the maximum values of the function $f(x) = \frac{(1+x)^{0.6}}{1+x^{0.6}}$ in $[0,\ 1]$, respectively, then the ordered pair $(k,\ K)$ is equal to:
(1) $\left(2^{-0.4}, 1\right)$ (2) $\left(2^{-0.6},\ 1\right)$
(3) $\left(2^{-0.4}, 2^{0.6}\right)$ (4) $\left(1, 2^{0.6}\right)$

Q82. If $\int \frac{\log\left(t+\sqrt{1+t^2}\right)}{\sqrt{1+t^2}}dt = \frac{1}{2}(g(t))^2 + c$, where c is a constant, then $g(2)$, is equal to

(1) $\frac{1}{\sqrt{5}}\log\left(2+\sqrt{5}\right)$ (2) $2\log\left(2+\sqrt{5}\right)$

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

Q83. Let $f : R \to R$ be a function such that $f(2-x) = f(2+x)$ and $f(4-x) = f(4+x)$, for all $x \in R$ and $\int_0^2 f(x)dx = 5$. Then the value of $\int_{10}^{50} f(x)dx$ is

(1) 100 (2) 125

(3) 80 (4) 200

Q84. Let $f : (-1,\ 1) \to R$ be a continuous function. If $\int_0^{\sin x} f(t)\ dt = \frac{\sqrt{3}}{2}x$, then $f\left(\frac{\sqrt{3}}{2}\right)$ is equal to:

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

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

Q85. The solution of the differential equation $y\mathrm{d}x - \left(x+2y^2\right)\mathrm{d}y = 0$ is $x = f(y)$. If $f(-1) = 1$, then $f(1)$ is equal to

(1) 2 (2) 3

(3) 4 (4) 1

Q86. In a parallelogram $ABCD$, $\left|\overrightarrow{AB}\right| = a$, $\left|\overrightarrow{AD}\right| = b$ & $\left|\overrightarrow{AC}\right| = c$. $\overrightarrow{DB}\cdot\overrightarrow{AB}$ has the value:

(1) $\frac{1}{2}\left(a^2+b^2+c^2\right)$ (2) $\frac{1}{4}\left(a^2+b^2-c^2\right)$

(3) $\frac{1}{3}\left(b^2+c^2-a^2\right)$ (4) $\frac{1}{2}\left(a^2-b^2+c^2\right)$

Q87. A plane containing the point $(3, 2, 0)$ and the line $\frac{x-1}{1} = \frac{y-2}{5} = \frac{z-3}{4}$ also contains the point

(1) $(0,\ 7,\ -10)$ (2) $(0,\ 7,\ 10)$

(3) $(0,\ 3,\ 1)$ (4) $(0,\ -3,\ 1)$

Q88. The shortest distance between the z - axis and the line $x+y+2z-3 = 0 = 2x+3y+4z-4$, is

(1) 1 (2) 2

(3) 3 (4) 4

Q89. If the mean and the variance of a binomial variate X are 2 & 1 respectively, then the probability that X takes a value greater than or equal to one is:

(1) $\frac{1}{16}$ (2) $\frac{9}{16}$

(3) $\frac{3}{4}$ (4) $\frac{15}{16}$

Q90. If the lengths of the sides of a triangle are decided by the three throws of a single fair die, then the probability that the triangle is of maximum area given that it is an isosceles triangle, is:

(1) $\frac{1}{69}$ (2) $\frac{1}{26}$

(3) $\frac{1}{21}$ (4) $\frac{1}{15}$

ANSWER KEYS

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