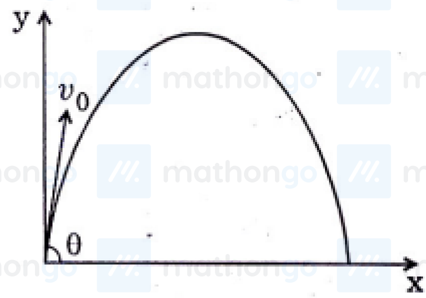
Q1. The respective number of significant figures for the numbers $23.023, 0.0003$ and 2.1×10^{-3} are

(1) $5, 1, 2$
(2) $5, 1, 5$
(3) $5, 5, 2$
(4) $4, 4, 2$

Q2. A particle is moving with velocity $\overrightarrow{\mathrm{v}} = \mathrm{K}(\mathrm{y}\hat{\mathrm{i}} + \mathrm{x}\hat{\mathrm{j}})$, where K is a constant. The general equation for its path is

(1) $y = x^2 +$ constant
(2) $y^2 = x +$ constant
(3) $xy =$ constant
(4) $y^2 = x^2 +$ constant

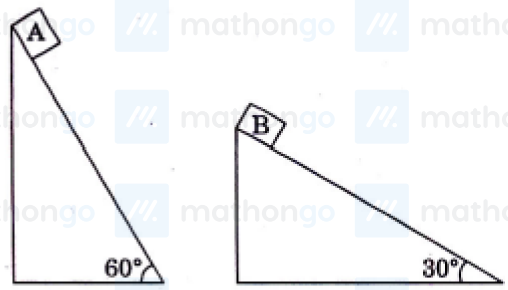
Q3. A small particle of mass m is projected at an angle θ with the x-axis with an initial velocity v_0 in the $\mathrm{x} - \mathrm{y}$ plane as shown in the figure. At a time $t < \frac{v_0 \sin\theta}{g}$, the angular momentum of the particle is where $\hat{\mathrm{i}}, \hat{\mathrm{j}}$ and $\hat{\mathrm{k}}$ are



unit vectors along x, y and z-axis respectively.

(1) $-\mathrm{mgv_0}\,\mathrm{t}^2 \cos\theta\hat{\mathrm{j}}$
(2) $\mathrm{mgv_0}\, t \cos\theta\hat{\mathrm{k}}$
(3) $-\frac{1}{2} mgv_0 t^2 \cos\theta\hat{k}$
(4) $\frac{1}{2} mgv_0 t^2 \cos\theta\hat{i}$

Q4. Two fixed frictionless inclined plane making an angle 30° and 60° with the vertical are shown in the figure. Two block A and B are placed on the two planes. What is the relative vertical acceleration of A with respect to



B ?

(1) $4.9\ \mathrm{ms}^{-2}$ in horizontal direction
(2) $9.8\ \mathrm{ms}^{-2}$ in vertical direction
(3) zero
(4) $4.9\ \mathrm{ms}^{-2}$ in vertical direction

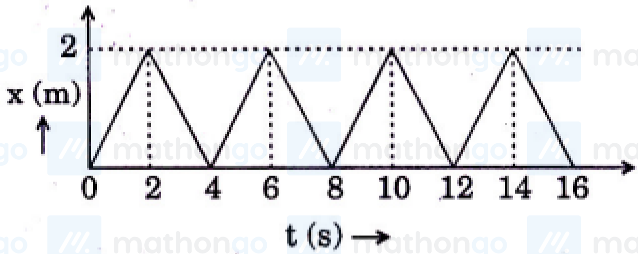
Q5. The potential energy function for the force between two atoms in a diatomic molecule is approximately given by $U(x) = \frac{a}{x^{12}} - \frac{b}{x^6}$, where a and b are constants and x is the distance between the atoms. If the dissociation energy of the molecule is $D = [U(x = \infty) - U_{\text{at equilbrium}}], D$ is

(1) $\frac{b^2}{2a}$
(2) $\frac{b^2}{12a}$
(3) $\frac{b^2}{4a}$
(4) $\frac{b^2}{6a}$

Q6. Statement-1 : Two particles moving in the same direction do not lose all their energy in a completely inelastic collision. Statement-2 : Principle of conservation of momentum holds true for all kinds of collisions. Of the four choices given after the statements, choose the one that best describes the two statements. Of the four choices given after the statements, choose the one that best describes the two statements.

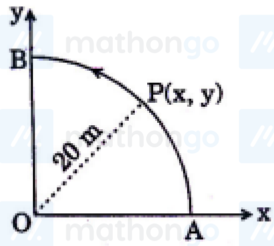
(1) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1.
(2) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement1
(3) Statement-1 is false, Statement-2 is true.
(4) Statement-1 is true, Statement-2 is false.

Q7. The figure shows the position - time $(x-t)$ graph of one-dimensional motion of a body of mass 0.4 kg. The



magnitude of each impulse is
(1) 0.4Ns
(2) 0.8Ns
(3) 1.6Ns
(4) 0.2Ns

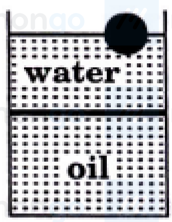
Q8. A point P moves in counter-clockwise direction on a circular path as shown in the figure. The movement of ' P ' is such that it sweeps out a length $s=t^3+5$, where s is in metres and t is in seconds. The radius of the path is

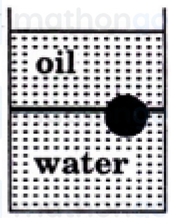


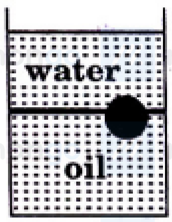
20 m. The acceleration of ' P ' when $t=2$ s is nearly
(1) $13 \mathrm{~m/s^2}$
(2) $12 \mathrm{~m/s^2}$
(3) $7.2 \mathrm{~m/s^2}$
(4) $14 \mathrm{~m/s^2}$

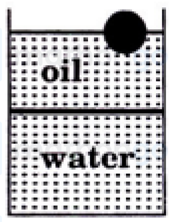
Q9. For a particle in uniform circular motion the acceleration $\vec{a}$ at a point $P(R, \theta)$ on the circle of radius R is (here θ is measured from the x-axis)
(1) $-\frac{v^2}{R}\cos\theta\hat{i}+\frac{v^2}{R}\sin\theta\hat{j}$
(2) $-\frac{v^2}{R}\sin\theta\hat{i}+\frac{v^2}{R}\cos\theta\hat{j}$
(3) $-\frac{v^2}{R}\cos\theta\hat{i}-\frac{v^2}{R}\sin\theta\hat{j}$
(4) $\frac{v^2}{R}\hat{i}+\frac{v^2}{R}\hat{j}$

Q10. A ball is made of a material of density ρ where $\rho_{\text{oil}}<\rho<\rho_{\text{water}}$ with ρ_{oil} and ρ_{water} representing the densities of oil and water, respectively. The oil and water are immiscible. If the above ball is in equilibrium in a mixture of this oil and water, which of the following pictures represents its equilibrium position?

(1)


(2)


(3)


(4)


Q11. Two conductors have the same resistance at $0^{\circ}\mathrm{C}$ but their temperature coefficients of resistance are α_1 and α_2. The respective temperature coefficients of their series and parallel combinations are nearly

(1) $\frac{\alpha_1+\alpha_2}{2}, \alpha_1+\alpha_2$
(2) $\alpha_1+\alpha_2, \frac{\alpha_1+\alpha_2}{2}$
(3) $\alpha_1+\alpha_2, \frac{\alpha_1\alpha_2}{\alpha_1+\alpha_2}$
(4) $\frac{\alpha_1+\alpha_2}{2}, \frac{\alpha_1+\alpha_2}{2}$

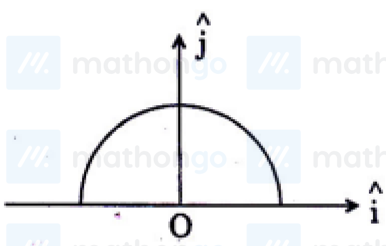
Q12. A diatomic ideal gas is used in a Car engine as the working substance. If during the adiabatic expansion part of the cycle, volume of the gas increases from V to 32 V the efficiency of the engine is

(1) 0.5
(2) 0.75
(3) 0.99
(4) 0.25

Q13. The equation of a wave on a string of linear mass density $0.04\ \mathrm{kg\ m^{-1}}$ is given by
$y=0.02(\mathrm{~m}) \sin \left[2 \pi\left(\frac{\mathrm{t}}{0.04(\mathrm{~s})}-\frac{\mathrm{x}}{0.50(\mathrm{~m})}\right)\right]$. The tension in the string is

(1) 4.0 N
(2) 12.5 N
(3) 0.5 N
(4) 6.25 N

Q14. A thin semi-circular ring of radius r has a positive charge q distributed uniformly over it. The net field $\vec{E}$ at the centre O is



(1) $\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$
(2) $-\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$
(3) $-\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$
(4) $\frac{\mathrm{q}}{2\pi^2\varepsilon_0 \mathrm{r}^2}\hat{\mathrm{j}}$

Q15. Let there be a spherically symmetric charge distribution with charge density varying as $\rho(r)=\rho_0\left(\frac{5}{4}-\frac{r}{R}\right)$ upto $r=R$, and $\rho(r)=0$ for $r>R$, where r is the distance from the origin. The electric field at a distance $r(r<R)$ from the origin is given by

(1) $\frac{4\pi\rho_0 r}{3\varepsilon_0}\left(\frac{5}{3}-\frac{r}{R}\right)$
(2) $\frac{\rho_0 r}{4\varepsilon_0}\left(\frac{5}{3}-\frac{r}{R}\right)$
(3) $\frac{4\rho_0 r}{3\varepsilon_0}\left(\frac{5}{4}-\frac{r}{R}\right)$
(4) $\frac{\rho_0 r}{3\varepsilon_0}\left(\frac{5}{4}-\frac{r}{R}\right)$

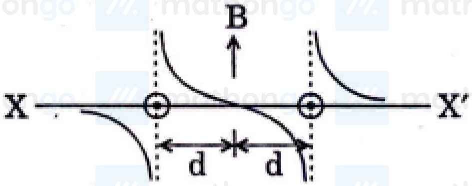
Q16. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 30° with each other. When suspended in a liquid of density 0.8 g cm^{-3}, the angle remains the same. If density of the material of the sphere is 16 g cm^{-3}, the dielectric constant of the liquid is

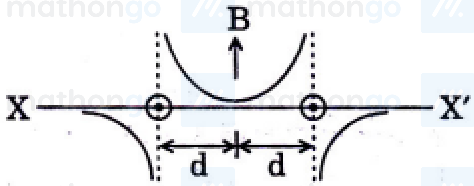
(1) 4
(2) 3
(3) 2
(4) 1

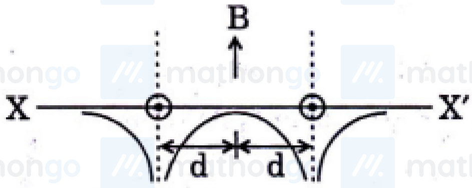
Q17. Let C be the capacitance of a capacitor discharging through a resistor R. Suppose t_1 is the time taken for the energy stored in the capacitor to reduce to half its initial value and t_2 is the time taken for the charge to reduce to one-fourth its initial value. Then the ratio t_1/t_2 will be

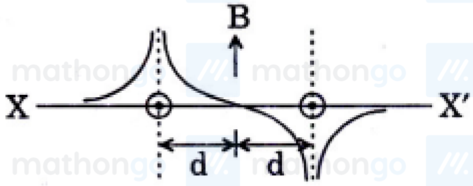
(1) 1
(2) $\frac{1}{2}$
(3) $\frac{1}{4}$
(4) 2

Q18. Two long parallel wires are at a distance 2 d apart. They carry steady equal current flowing out of the plane of the paper as shown. The variation of the magnetic field along the line XX ' is given by

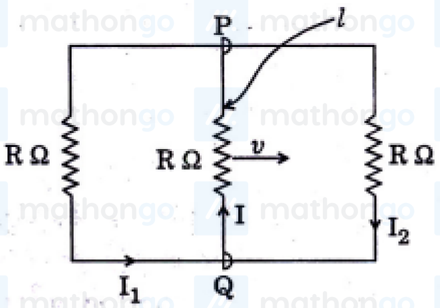
(1)


(2)


(3)


(4)


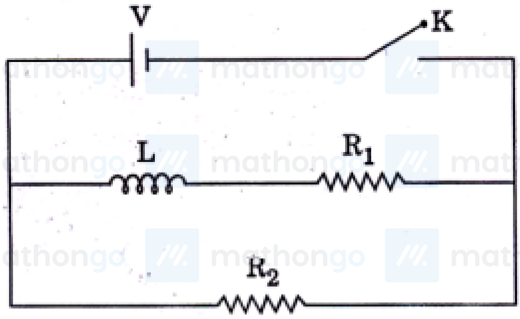
Q19. A rectangular loop has a sliding connector PQ of length ℓ and resistance $R\Omega$ and it is moving with a speed v as shown. The set-up is placed in a uniform magnetic field going into the plane of the paper. The three currents



I_1, I_2 and I are

(1) $\mathrm{I}_1 = -\mathrm{I}_2 = \frac{\mathrm{B}\ell\mathrm{v}}{\mathrm{R}}, \mathrm{I} = \frac{2\,\mathrm{B}\ell\mathrm{v}}{\mathrm{R}}$
(2) $\mathrm{I}_1 = \mathrm{I}_2 = \frac{\mathrm{B}\ell\mathrm{v}}{3\mathrm{R}}, \mathrm{I} = \frac{2\,\mathrm{B}\ell\mathrm{v}}{3\mathrm{R}}$
(3) $l_1 = I_2 = I = \frac{B\ell v}{R}$
(4) $I_1 = I_2 = \frac{B\ell v}{6R}, I = \frac{B\ell v}{3R}$

Q20. In the circuit shown below, the key K is closed at $t=0$. The current through the battery is



(1) $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at $t=0$ and $\frac{V}{R_2}$ at $t=\infty$

(2) $\frac{V}{R_2}$ at $t=0$ and $\frac{V(R_1+R_2)}{R_1R_2}$ at $t=\infty$

(3) $\frac{V}{R_2}$ at $t=0$ and $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at $t=\infty$

(4) $\frac{V(R_1+R_2)}{R_1R_2}$ at $t=0$ and $\frac{V}{R_2}$ at $t=\infty$

Q21. In a series LCR circuit $R=200\Omega$ and the voltage and the frequency of the main supply is 220 V and 50 Hz respectively. On taking out the capacitance from the circuit the current lags behind the voltage by 30°. On taking out the inductor from the circuit the current leads the voltage by 30°. The power dissipated in the LCR circuit is

(1) 305 W
(2) 210 W
(3) Zero W
(4) 242 W

Q22. If a source of power 4 kW produces 10^{20} photons/second, the radiation belong to a part of the spectrum called

(1) X-rays
(2) ultraviolet rays
(3) microwaves
(4) γ-rays

Q23. An initially parallel cylindrical beam travels in a medium of refractive index $\mu(I)=\mu_0+\mu_2 I$, where μ_0 and μ_2 are positive constants and I is the intensity of the light beam. The intensity of the beam is decreasing with increasing radius. As the beam enters the medium, it will

(1) diverge
(2) converge
(3) diverge near the axis and converge near the periphery
(4) travel as a cylindrical beam

Q24. An initially parallel cylindrical beam travels in a medium of refractive index $\mu(I)=\mu_0+\mu_2 I$, where μ_0 and μ_2 are positive constants and I is the intensity of the light beam. The intensity of the beam is decreasing with increasing radius. The initial shape of the wave front of the beam is

(1) convex
(2) concave
(3) convex near the axis and concave near the periphery
(4) planar

Q25. An initially parallel cylindrical beam travels in a medium of refractive index $\mu(I)=\mu_0+\mu_2 I$, where μ_0 and μ_2 are positive constants and I is the intensity of the light beam. The intensity of the beam is decreasing with increasing radius. The speed of light in the medium is

(1) minimum on the axis of the beam
(2) the same everywhere in the beam
(3) directly proportional to the intensity I
(4) maximum on the axis of the beam

Q26. Statement-1 : When ultraviolet light is incident on a photocell, its stopping potential is V_0 and the maximum kinetic energy of the photoelectrons is $\mathrm{K}_{\max}$. When the ultraviolet light is replaced by X− rays, both V_0 and $\mathrm{K}_{\max}$ increase. Statement-2 : Photoelectrons are emitted with speeds ranging from zero to a maximum value because of the range of frequencies present in the incident light. Of the four choices given after the statements, choose the one that best describes the two statements.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1.
(2) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement- 1.
(3) Statement-1 is false, Statement-2 is true.
(4) Statement-1 is true, Statement- 2 is false.

Q27. A nucleus of mass $M+\Delta m$ is at rest and decays into two daughter nuclei of equal mass $\frac{M}{2}$ each. Speed of light is c. 40. The binding energy per nucleon for the parent nucleus is E_1 and that for the daughter nuclei is E_2. Then

(1) $\mathrm{E}_2=2\mathrm{E}_1$
(2) $E_1>E_2$
(3) $E_2>E_1$
(4) $\mathrm{E}_1=2\mathrm{E}_2$

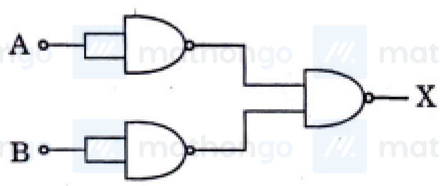
Q28. A nucleus of mass $M+\Delta m$ is at rest and decays into two daughter nuclei of equal mass $\frac{M}{2}$ each. Speed of light is C. The speed of daughter nuclei is

(1) $c\frac{\Delta m}{M+\Delta m}$
(2) $c\sqrt{\frac{2\Delta m}{M}}$
(3) $c\sqrt{\frac{\Delta \mathrm{m}}{\mathrm{M}}}$
(4) $c\sqrt{\frac{\Delta m}{M+\Delta m}}$

Q29. A radioactive nucleus (initial mass number A and atomic number Z) emits 3α-particles and 2 positrons. The ratio of number of neutrons to that of protons in the final nucleus will be

(1) $\frac{A-Z-8}{Z-4}$
(2) $\frac{A-Z-4}{Z-8}$
(3) $\frac{A-Z-12}{Z-4}$
(4) $\frac{A-Z-4}{Z-2}$

Q30.



The combination of gates shown below yields

(1) OR gate
(2) NOT gate
(3) XOR gate
(4) NAND gate

Q31. Ionisation energy of He^+ is 19.6×10^{-18} Jatom^{-1}. The energy of the first stationary state $(\mathrm{n}=1)$ of Li^{2+} is

(1) 4.41×10^{-16} Jatom^{-1}
(2) -4.41×10^{-17} $\mathrm{J_{atom}}^{-1}$
(3) -2.2×10^{-15} Jatom^{-1}
(4) 8.82×10^{-17} $\mathrm{J_{atom}}^{-1}$

Q32. The correct sequence which shows decreasing order of the ionic radii of the elements is

(1) $\mathrm{Al}^{3+}>\mathrm{Mg}^{2+}>\mathrm{Na}^+>\mathrm{F}^->\mathrm{O}^{2-}$
(2) $\mathrm{Na}^+>\mathrm{Mg}^{2+}>\mathrm{Al}^{3+}>\mathrm{O}^{2-}>\mathrm{F}$
(3) $\mathrm{Na}^+>\mathrm{F}>\mathrm{Mg}^{2+}>\mathrm{O}^{2-}>\mathrm{Al}^{3+}$
(4) $\mathrm{O}^{2-}>\mathrm{F}>\mathrm{Na}^+>\mathrm{Mg}^{2+}>\mathrm{Al}^{3+}$

Q33. The standard enthalpy of formation of NH_3 is -46.0 kJ mol^{-1}. If the enthalpy of formation of H_2 from its atoms is -436 kJ mol^{-1} and that of N_2 is -712 kJ mol^{-1}, the average bond enthalpy of N − H bond in NH_3

is

(1) -964 kJ mol^{-1}
(2) $+352 \text{ kJ mol}^{-1}$
(3) $+1056 \text{ kJ mol}^{-1}$
(4) $-1102 \text{ kJ mol}^{-1}$

Q34. The energy required to break one mole of $\mathrm{Cl-Cl}$ bonds in $\mathrm{Cl_2}$ is 242 kJ mol^{-1}. The longest wavelength of light capable of breaking a single $\mathrm{Cl-Cl}$ bond is $\left(c = 3 \times 10^8 \text{ ms}^{-1} \text{ and } \mathrm{N_A} = 6.02 \times 10^{23} \text{ mol}^{-1}\right)$

(1) 594 nm
(2) 640 nm
(3) 700 nm
(4) 494 nm

Q35. For a particular reversible reaction at temperature T, ΔH and ΔS were found to be both $+ve$. If T_e is the temperature at equilibrium, the reaction would be spontaneous when

(1) $T_e > T$
(2) $\mathrm{T} > \mathrm{T_e}$
(3) T_e is 5 times T
(4) $T = T_e$

Q36. In aqueous solution the ionization constants for carbonic acid are $\mathrm{K_1} = 4.2 \times 10^{-7}$ and $\mathrm{K_2} = 4.8 \times 10^{-11}$ Select the correct statement for a saturated 0.034M solution of the carbonic acid.

(1) The concentration of $\mathrm{CO_3^{2-}}$ is 0.034M.
(2) The concentration of $\mathrm{CO_3^{2-}}$ is greater than that of $\mathrm{HCO_3^-}$.
(3) The concentration of $\mathrm{H^+}$and $\mathrm{HCO_3^-}$are approximately equal.
(4) The concentration of $\mathrm{H^+}$is double that of $\mathrm{CO_3^{2-}}$.

Q37. Solubility product of silver bromide is 5.0×10^{-13}. The quantity of potassium bromide (molar mass precipitation of AgBr is

(1) 1.2×10^{-10} g
(2) 1.2×10^{-9} g
(3) 6.2×10^{-5} g
(4) 5.0×10^{-8} g

Q38. At $25^\circ\mathrm{C}$, the solubility product of $\mathrm{Mg(OH)_2}$ is 1.0×10^{-11}. At which pH, will $\mathrm{Mg^{2+}}$ ions start precipitating in the form of $\mathrm{Mg(OH)_2}$ from a solution of $0.001\mathrm{MMg^{2+}}$ ions ?

(1) 9
(2) 10
(3) 11
(4) 8

Q39. 29.5mg of an organic compound containing nitrogen was digested according to Kjeldahl's method and the evolved ammonia was absorbed in 20 mL of 0.1MHCl solution. The excess of the acid required 15 mL of 0.1MNaOH solution for complete neutralization. The percentage of nitrogen in the compound is

(1) 59.0
(2) 47.4
(3) 23.7
(4) 29.5

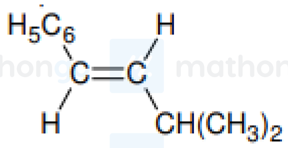
Q40. The correct order of increasing basicity of the given conjugate bases $(\mathrm{R} = \mathrm{CH_3})$ is

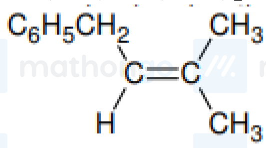
(1) $\mathrm{RCO\overline{O}} < \mathrm{HC} = \overline{\mathrm{C}} < \overline{\mathrm{R}} < \overline{\mathrm{N}}\mathrm{H_2}$
(2) $\overline{\mathrm{R}} < \mathrm{HC} \equiv \overline{\mathrm{C}} < \mathrm{RCO\overline{O}} < \overline{\mathrm{N}}\mathrm{H_2}$
(3) $\mathrm{RCO\overline{O}} < \overline{\mathrm{N}}\mathrm{H_2} < \mathrm{HC} \equiv \overline{\mathrm{C}} < \overline{\mathrm{R}}$
(4) $\mathrm{RCO\overline{O}} < \mathrm{HC} \equiv \overline{\mathrm{C}} < \overline{\mathrm{N}}\mathrm{H_2} < \overline{\mathrm{R}}$

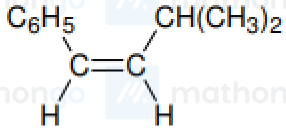
Q41. Out of the following, the alkene that exhibits optical isomerism is

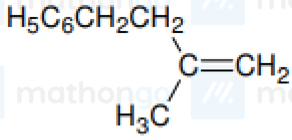
(1) 3-methyl-2-pentene
(2) 4-methyl-1-pentene
(3) 3-methyl-1-pentene
(4) 2-methyl-2-pentene

Q42. The main product of the following reaction is $C_6H_5CH_2CH(OH)CH(CH_3)_2 \xrightarrow{\text{conc. } H_2SO_4}$?

(1) 

(2) 

(3) 

(4) 

Q43. The edge length of a face centered cubic cell of an ionic substance is 508pm. If the radius of the cation is 110pm, the radius of the anion is

(1) 288pm
(2) 398pm
(3) 618pm
(4) 144pm

Q44. Percentage of free space in cubic close packed structure and in body centred packed structure are respectively

(1) 30% and 26%
(2) 26% and 32%
(3) 32% and 48%
(4) 48% and 26%

Q45. If 10^{-4}dm^3 of water is introduced into a 1.0dm^3 flask to 300 K, how many moles of water are in the vapour phase when equilibrium is established? (Given : Vapour pressure of H_2O at 300 K is $3170\ \mathrm{Pa}; \mathrm{R} = 8.314\ \mathrm{J\ K^{-1}\ mol^{-1}}$)

(1) 5.56×10^{-3} mol
(2) 1.53×10^{-2} mol
(3) 4.46×10^{-2} mol
(4) 1.27×10^{-3} mol

Q46. If sodium sulphate is considered to be completely dissociated into cations and anions in aqueous solution, the change in freezing point of water (ΔT_f), when 0.01 mol of sodium sulphate is dissolved in 1 kg of water, is $\left(K_f = 1.86\ \mathrm{K\ kg\ mol^{-1}}\right)$

(1) 0.0372 K
(2) 0.0558 K
(3) 0.0744 K
(4) 0.0186 K

Q47. On mixing, heptane and octane form an ideal solution. At 373 K, the vapour pressures of the two liquid components (heptane and octane) are 105kPa and 45kPa respectively. Vapour pressure of the solution obtained by mixing 25.0 g of heptane and 35 g of octane will be (molar mass of heptane $= 100\ \mathrm{g\ mol^{-1}}$ an dof octane $= 114\ \mathrm{g\ mol^{-1}}$).

(1) 72.0kPa
(2) 36.1kPa
(3) 96.2kPa
(4) 144.5kPa

Q48. The Gibbs energy for the decomposition of Al_2O_3 at 500°C is as follows :

$$\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3}Al + O_2, \Delta_r G = +966\ \mathrm{kJ\ mol^{-1}}$$

The potential difference needed for electrolytic reduction of Al_2O_3 at 500°C is at least

(1) 4.5 V
(2) 3.0 V
(3) 2.5 V
(4) 5.0 V

Q49. The correct order of $E^0_{SR^2/M}$ values with negative sign for the four successive elements Cr, Mn, Fe and Co is

(1) $Mn > Cr > Fe > Co$
(2) $Cr > Fe > Mn > Co$
(3) $Fe > Mn > Cr > Co$
(4) $Cr > Mn > Fe > Co$

Q50. The time for half life period of a certain reaction $A \rightarrow$ products is 1 hour. When the initial concentration of the reactant ' A ', is 2.0 mol L^{-1}, how much time does it take for its concentration to come from 0.50 to 0.25 mol L^{-1} if it is a zero order reaction?

(1) 4 h
(2) 0.5 h
(3) 0.25 h
(4) 1 h

Q51. Consider the reaction :

$$Cl_2(aq) + H_2S(aq) \rightarrow S(s) + 2H^+(aq) + 2Cl^-(aq)$$

The rate equation for this reaction is rate $= k[Cl_2][H_2S]$ Which of these mechanisms is/are consistent with this rate equation? (A) $Cl_2 + H_2 \rightarrow H^+ + Cl^- + Cl^+ + HS^-$ (slow)

$$Cl^+ + HS^- \rightarrow H^+ + Cl^- + S \text{ (fast)}$$

(B) $H_2S \Leftrightarrow H^+ + HS^-$ (fast equilibrium) $Cl_2 + HS^- \rightarrow 2Cl^- + H^+ + S$ (slow)

(1) B only
(2) Both A and B
(3) Neither A nor B
(4) A only

Q52. Three reactions involving $H_2PO_4^-$ are given below : (i) $H_3PO_4 + H_2O \rightarrow H_3O^+ + H_2PO_4^-$ (ii) $H_2PO_4^- + H_2O \rightarrow HPO_4^{2-} + H_3O^+$ (iii) $H_2PO_4^- + OH^- \rightarrow H_3PO_4 + O^{2-}$ In which of the above does $H_2PO_4^-$ act as an acid ?

(1) (ii) only
(2) (i) and (ii)
(3) (iii) only
(4) (i) only

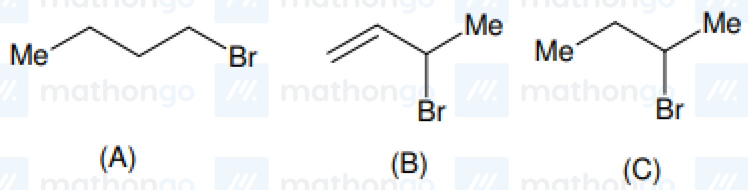
Q53. A solution containing 2.675 g of $CoCl_3.6NH_3$ (molar mass = 267.5 g mol^{-1}) is passed through a cation exchanger. The chloride ions obtained in solution were treated with excess of $AgNO_3$ to give 4.78 g of AgCl (molar mass = 143.5 g mol^{-1}). The formula of the complex is (At. Mass of Ag = 108u)

(1) $[Co(NH_3)_6]Cl_3$
(2) $[CoCl_2(NH_3)_4]Cl$
(3) $[CoCl_3(NH_3)_3]$
(4) $[CoCl(NH_3)_5]Cl_2$

Q54. Which one of the following has an optical isomer ? (en = ethylenediamine)

(1) $[Zn(en)(NH_3)_2]^{2+}$
(2) $[Co(en)_3]^{3+}$
(3) $[Co(H_2O)_4(en)]^{3+}$
(4) $[Zn(en)_2]^{2+}$

Q55.



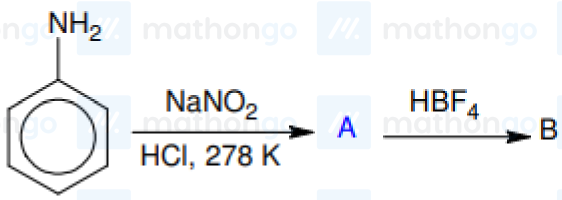
Consider the following bromides :
The correct order of S_N1 reactivity is

(1) $B > C > A$
(2) $B > A > C$
(3) $C > B > A$
(4) $A > B > C$

Q56. From amongst the following alcohols the one that would react fastest with conc. HCl and anhydrous $ZnCl_2$, is
(1) 2-Butanol
(2) 2-Methylpropan-2-ol
(3) 2-Methylpropanol
(4) 1-Butanol

Q57. One mole of a symmetrical alkene on ozonolysis gives two moles of an aldehyde having a molecular mass of 44u. The alkene is
(1) propene
(2) 1-butene
(3) 2-butene
(4) ethene

Q58.



In the chemical reactions,
the compounds ' A ' and ' B ' respectively are
(1) nitrobenzene and fluorobenzene
(2) phenol and benzene
(3) benzene diazonium chloride and fluorobenzene
(4) nitrobenzene and chlorobenzene

Q59. The polymer containing strong intermolecular forces e.g. hydrogen bonding, is
(1) teflon
(2) nylon 6,6
(3) polystyrene
(4) natural rubber

Q60. Biuret test is not given by
(1) carbohydrates
(2) polypeptides
(3) urea
(4) proteins

Q61. If α and β are the roots of the equation $x^2 - x + 1 = 0$, then $\alpha^{2009} + \beta^{2009} =$
(1) -1
(2) 1
(3) 2
(4) -2

Q62. The number of complex numbers z such that $|z-1| = |z+1| = |z-i|$ equals
(1) 1
(2) 2
(3) ∞
(4) 0

Q63. There are two urns. Urn A has 3 distinct red balls and urn B has 9 distinct blue balls. From each urn two balls are taken out at random and then transferred to the other. The number of ways in which this can be done is
(1) 36
(2) 66
(3) 108
(4) 3

Q64. A person is to count 4500 currency notes. Let a_n denote the number of notes he counts in the n^{th} minute. If $\mathrm{a}_1 = \mathrm{a}_2 = \ldots\ldots = \mathrm{a}_{10} = 150$ and $\mathrm{a}_{10}, \mathrm{a}_{11}, \ldots\ldots$ are in A.P. with common difference -2, then the time taken by him to count all notes is

(1) 34 minutes
(2) 125 minutes
(3) 135 minutes
(4) 24 minutes

Q65. Let $\mathrm{S}_1=\sum_{\mathrm{j}=1}^{10} \mathrm{j}(\mathrm{j}-1)^{10} \mathrm{C}_{\mathrm{j}}, \mathrm{S}_2=\sum_{\mathrm{j}=1}^{10} \mathrm{j}^{10} \mathrm{C}_{\mathrm{j}}$ and $\mathrm{S}_3=\sum_{\mathrm{j}=1}^{10} \mathrm{j}^{2\,10} \mathrm{C}_{\mathrm{j}}$. Statement-1: $\mathrm{S}_3=55 \times 2^9$ Statement-2: $S_1=90 \times 2^8$ and $S_2=10 \times 2^8$.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation for Statement-1
(2) Statement-1 is true, Statement-2 is false
(3) Statement-1 is false, Statement-2 is true
(4) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation for Statement-1

Q66. Let $\cos (\alpha+\beta)=\frac{4}{5}$ and let $\sin (\alpha-\beta)=\frac{5}{13}$, where $0 \leq \alpha, \beta \leq \frac{\pi}{4}$, then $\tan 2 \alpha=$

(1) $\frac{56}{33}$
(2) $\frac{19}{12}$
(3) $\frac{20}{7}$
(4) $\frac{25}{16}$

Q67. The line L given by $\frac{x}{5}+\frac{y}{b}=1$ passes through the point $(13,32)$. The line K is parallel to L and has the equation $\frac{x}{c}+\frac{y}{3}=1$. Then the distance between L and K is

(1) $\sqrt{17}$
(2) $\frac{17}{\sqrt{15}}$
(3) $\frac{23}{\sqrt{17}}$
(4) $\frac{23}{\sqrt{15}}$

Q68. The circle $x^2+y^2=4 x+8 y+5$ intersects the line $3 x-4 y=m$ at two distinct points if

(1) $-35<m<15$
(2) $15<m<65$
(3) $35<m<85$
(4) $-85<m<-35$

Q69. If two tangents drawn from a point P to the parabola $y^2=4 x$ are at right angles, then the locus of P is

(1) $2 x+1=0$
(2) $x=-1$
(3) $2 x-1=0$
(4) $x=1$

Q70. Let $f: R \rightarrow R$ be a positive increasing function with $\lim _{x \rightarrow \infty} \frac{f(3 x)}{f(x)}=1$. Then $\lim _{x \rightarrow \infty} \frac{f(2 x)}{f(x)}=$

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

Q71. For two data sets, each of size 5 , the variances are given to be 4 and 5 and the corresponding means are given to be 2 and 4 , respectively. The variance of the combined data set is

(1) $\frac{11}{2}$
(2) 6
(3) $\frac{13}{2}$
(4) $\frac{5}{2}$

Q72. For a regular polygon, let r and R be the radii of the inscribed and the circumscribed circles. A false statement among the following is

(1) There is a regular polygon with $\frac{r}{R}=\frac{1}{\sqrt{2}}$
(2) There is a regular polygon with $\frac{r}{R}=\frac{2}{3}$
(3) There is a regular polygon with $\frac{r}{R}=\frac{\sqrt{3}}{2}$
(4) There is a regular polygon with $\frac{r}{R}=\frac{1}{2}$

Q73. Let S be a non-empty subset of R. Consider the following statement: P : There is a rational number $\mathrm{x} \in \mathrm{S}$ such that $\mathrm{x}>0$. Which of the following statements is the negation of the statement P ?

(1) There is no rational number $x \in S$ such that $x \leq 0$

(2) Every rational number $x \in S$ satisfies $x \leq 0$

(3) $x \in S$ and $x \leq 0 \Rightarrow x$ is not rational

(4) There is a rational number $x \in S$ such that $x \leq 0$

Q74. Consider the following relations: $R = \{(x, y) \mid x, y$ are real numbers and $x =$ wy for some rational number w $\}$; $S = \left\{\left(\frac{m}{n}, \frac{p}{q}\right) \mid m, n, p\right.$ and q are integers such that $n, q \neq 0$ and $qm = pn\}$. Then

(1) neither R nor S is an equivalence relation

(2) S is an equivalence relation but R is not an equivalence relation

(3) R and S both are equivalence relations

(4) R is an equivalence relation but S is not an equivalence relation

Q75. The number of 3×3 non-singular matrices, with four entries as 1 and all other entries as 0 , is

(1) 5

(2) 6

(3) at least 7

(4) less than 4

Q76. Let A be a 2×2 matrix with non-zero entries and let $A^2 = 1$, where 1 is 2×2 identity matrix. Define $\operatorname{Tr}(\mathrm{A}) =$ sum of diagonal elements of A and $|A| =$ determinant of matrix A. Statement-1: $\operatorname{Tr}(\mathrm{A}) = 0$ Statement-2: $|\mathrm{A}| = 1$

(1) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation for Statement-1

(2) Statement-1 is true, Statement-2 is false

(3) Statement-1 is false, Statement-2 is true

(4) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation for Statement-1

Q77. Consider the system of linear equations:

$$\begin{aligned} x_1 + 2x_2 + x_3 &= 3 \\ 2x_1 + 3x_2 + x_3 &= 3 \\ 3x_1 + 5x_2 + 2x_3 &= 1 \end{aligned}$$

The system has

(1) exactly 3 solutions

(2) a unique solution

(3) no solution

(4) infinite number of solutions

Q78. Let $f: R \rightarrow R$ be a continuous function defined by $f(x) = \frac{1}{e^x + 2e^{-x}}$. Statement-1: $f(c) = \frac{1}{3}$, for some $c \in R$. Statement-2: $0 < f(x) \leq \frac{1}{2\sqrt{2}}$, for all $x \in R$

(1) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation for Statement-1

(2) Statement-1 is true, Statement-2 is false

(3) Statement-1 is false, Statement-2 is true

(4) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation for Statement-1

Q79. Let $f:(-1,1)\rightarrow R$ be a differentiable function with $f(0)=-1$ and $f'(0)=1$. Let $g(x)=[f(2f(x)+2)]^2$. Then $g'(0)=$

(1) -4
(2) 0
(3) -2
(4) 4

Q80. The equation of the tangent to the curve $y=x+\frac{4}{x^2}$, that is parallel to the x-axis, is

(1) $y=1$
(2) $y=2$
(3) $y=3$
(4) $y=0$

Q81. Let $f:R\rightarrow R$ be defined by $f(x)=\begin{cases}k-2x, & \text{if } x\leq -1\\ 2x+3, & \text{if } x>-1\end{cases}$ If f has a local minimum at $x=-1$, then a possible value of k is

(1) 0
(2) $-\frac{1}{2}$
(3) -1
(4) 1

Q82. Let $p(x)$ be a function defined on R such that $p'(x)=p'(1-x)$, for all $x\in[0,1], p(0)=1$ and $p(1)=41$. Then $\int_0^1 p(x)dx$ equals

(1) 21
(2) 41
(3) 42
(4) $\sqrt{41}$

Q83. The area bounded by the curves $y=\cos x$ and $y=\sin x$ between the ordinates $x=0$ and $x=\frac{3\pi}{2}$ is

(1) $4\sqrt{2}+2$
(2) $4\sqrt{2}-1$
(3) $4\sqrt{2}+1$
(4) $4\sqrt{2}-2$

Q84. Solution of the differential equation $\cos x dy=y(\sin x-y)dx, 0<x<\frac{\pi}{2}$ is

(1) $y\sec x=\tan x+c$
(2) $y\tan x=\sec x+c$
(3) $\tan x=(\sec x+c)y$
(4) $\sec x=(\tan x+c)y$

Q85. Let $\vec{a}=\hat{j}-\hat{k}$ and $\vec{c}=\hat{i}-\hat{j}-\hat{k}$. Then vector $\vec{b}$ satisfying $\vec{a}\times\vec{b}+\vec{c}=\overrightarrow{0}$ and $\vec{a}\cdot\vec{b}=3$ is

(1) $2\hat{i}-\hat{j}+2\hat{k}$
(2) $\hat{i}-\hat{j}-2\hat{k}$
(3) $\hat{i}+\hat{j}-2\hat{k}$
(4) $-\hat{i}+\hat{j}-2\hat{k}$

Q86. If the vectors $\overrightarrow{\mathrm{a}}=\hat{\mathrm{i}}-\hat{\mathrm{j}}+2\hat{\mathrm{k}}, \overrightarrow{\mathrm{b}}=2\hat{\mathrm{i}}+4\hat{\mathrm{j}}+\hat{\mathrm{k}}$ and $\overrightarrow{\mathrm{c}}=\lambda\hat{\mathrm{i}}+\hat{\mathrm{j}}+\mu\hat{\mathrm{k}}$ are mutually orthogonal, then $(\lambda,\mu)=$

(1) $(2,-3)$
(2) $(-2,3)$
(3) $(3,-2)$
(4) $(-3,2)$

Q87. Statement-1: The point $A(3,1,6)$ is the mirror image of the point $B(1,3,4)$ in the plane $x-y+z=5$.
Statement-2: The plane $x-y+z=5$ bisects the line segment joining $A(3,1,6)$ and $B(1,3,4)$.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation for Statement-1
(2) Statement-1 is true, Statement-2 is false
(3) Statement-1 is false, Statement-2 is true
(4) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation for Statement-1

Q88. A line AB in three-dimensional space makes angles 45° and 120° with the positive x-axis and the positive y-axis respectively. If AB makes an acute angle θ with the positive z-axis, then θ equals

(1) 45°
(2) 60°
(3) 75°
(4) 30°

Q89. Four numbers are chosen at random (without replacement) from the set $\{1, 2, 3, \ldots., 20\}$. Statement-1: The probability that the chosen numbers when arranged in some order will form an AP is $\frac{1}{85}$. Statement-2: If the four chosen numbers from an AP, then the set of all possible values of common difference is $\{\pm 1, \pm 2, \pm 3, \pm 4, \pm 5\}$.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation for Statement-1
(2) Statement-1 is true, Statement-2 is false
(3) Statement-1 is false, Statement-2 is true
(4) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation for Statement-1

Q90. An urn contains nine balls of which three are red, four are blue and two are green. Three balls are drawn at random without replacement from the urn. The probability that the three balls have different colour is

(1) $\frac{2}{7}$
(2) $\frac{1}{21}$
(3) $\frac{2}{23}$
(4) $\frac{1}{3}$

ANSWER KEYS

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