Q1. A person standing on an open ground hears the sound of a jet aeroplane, coming from north at an angle 60^o with ground level, but he finds the aeroplane right vertically above his position. If v is the speed of sound, speed of the plane is:

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

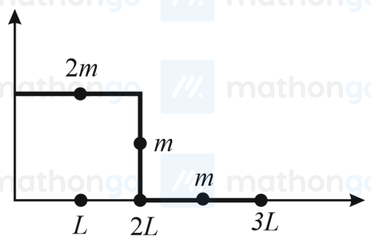
Q2. A passenger train of length 60 m travels at a speed of 80 km / hr. Another freight train of length 120 m travels at a speed of 30 km / hr. The ratio of times taken by the passenger train to completely cross the freight train when: (i) they are moving in the same direction, and (ii) in the opposite directions is:

(1) $\frac{5}{2}$
(2) $\frac{3}{2}$
(3) $\frac{11}{5}$
(4) $\frac{25}{11}$

Q3. A simple pendulum, made of a string of length l and a bob of mass m, is released from a small angle θ_0. It strikes a block of mass M, kept on horizontal surface at its lowest point of oscillations, elastically. It bounces back and goes up to an angle θ_1. Then M is given by:

(1) $m\left(\frac{\theta_0-\theta_1}{\theta_0+\theta_1}\right)$
(2) $m\left(\frac{\theta_0+\theta_1}{\theta_0-\theta_1}\right)$
(3) $\frac{m}{2}\left(\frac{\theta_0+\theta_1}{\theta_0-\theta_1}\right)$
(4) $\frac{m}{2}\left(\frac{\theta_0-\theta_1}{\theta_0+\theta_1}\right)$

Q4. The position vector of the center of mass $\overrightarrow{\mathrm{r}}_{\mathrm{cm}}$ of an asymmetric uniform bar of negligible area of cross-section as shown in figure is:



(1) $\overrightarrow{\mathrm{r}}_{\mathrm{cm}} = \frac{13}{8}\mathrm{L}\hat{\mathrm{x}} + \frac{5}{8}\mathrm{L}\hat{\mathrm{y}}$
(2) $\overrightarrow{\mathrm{r}}_{\mathrm{cm}} = \frac{5}{8}\mathrm{L}\hat{\mathrm{x}} + \frac{13}{8}\mathrm{L}\hat{\mathrm{y}}$
(3) $\overrightarrow{\mathrm{r}}_{\mathrm{cm}} = \frac{3}{8}\mathrm{L}\hat{\mathrm{x}} + \frac{11}{8}\mathrm{L}\hat{\mathrm{y}}$
(4) $\overrightarrow{\mathrm{r}}_{\mathrm{cm}} = \frac{11}{8}\mathrm{L}\hat{\mathrm{x}} + \frac{3}{8}\mathrm{L}\hat{\mathrm{y}}$

Q5. Let the moment of inertia of a hollow cylinder of length 30 cm (inner radius 10 cm and outer radius 20 cm), about its axis be I . The radius of a thin cylinder of the same mass such that its moment of inertia about its axis is also I, is:

(1) 16 cm
(2) 14 cm
(3) 12 cm
(4) 18 cm

Q6. A satellite of mass M is in a circular orbit of radius R about the center of the earth. A meteorite of the same mass, falling towards the earth, collides with the satellite completely inelastic. The speeds of the satellite and the meteorite are the same, just before the collision. The subsequent motion of the combined body will be:

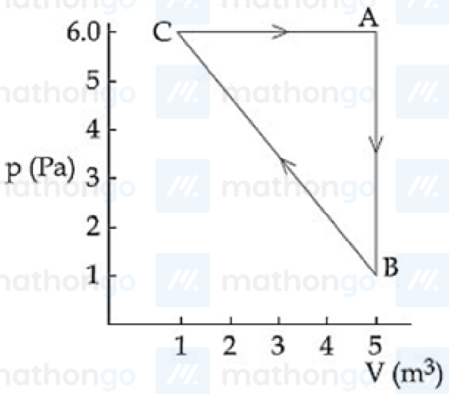
(1) In an elliptical orbit
(2) Such that it escapes to infinity
(3) In a circular orbit of a different radius
(4) In the same circular orbit of radius R

Q7. A straight rod of length L extends from $x = a$ to $x = L + a$. The gravitational force it exerts on a point mass 'm' at $x = 0$, if the mass per unit length of the rod is $A + Bx^2$, is given by:

(1) $Gm\left[A\left(\frac{1}{a+L}-\frac{1}{a}\right)+BL\right]$
(2) $Gm\left[A\left(\frac{1}{a+L}-\frac{1}{a}\right)-BL\right]$
(3) $Gm\left[A\left(\frac{1}{a}-\frac{1}{a+L}\right)-BL\right]$
(4) $Gm\left[A\left(\frac{1}{a}-\frac{1}{a+L}\right)+BL\right]$

Q8. A cylinder of radius R is surrounded by a cylindrical shell of inner radius R and outer radius $2R$. The thermal conductivity of the material of the inner cylinder is K_1 and that of the outer cylinder is K_2. Assuming no loss of heat, the effective thermal conductivity of the system for heat flowing along the length of the cylinder is:
(1) $\frac{2K_1+3K_2}{5}$
(2) $\frac{K_1+K_2}{2}$
(3) K_1+K_2
(4) $\frac{K_1+3K_2}{4}$

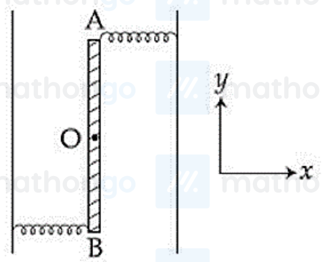
Q9. For the given cyclic process CAB as shown for a gas, the work done is:



(1) 10 J
(2) 5 J
(3) 1 J
(4) 30 J

Q10. An ideal gas occupies a volume of 2 m^3 at a pressure of 3×10^6 Pa. The energy of the gas is:
(1) $10^8 J$
(2) $9\times10^6 J$
(3) $3\times10^2 J$
(4) $6\times10^4 J$

Q11. Two light identical springs of spring constant k are attached horizontally at the two ends of a uniform horizontal rod AB of length l and mass m. The rod is pivoted at its center 'O' and can rotate freely in horizontal plane. The other ends of the two springs are fixed to rigid supports as shown in figure. The rod is gently pushed through a small angle and released. The frequency of resulting oscillation is:



(1) $\frac{1}{2\pi}\sqrt{\frac{3k}{m}}$
(2) $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$
(3) $\frac{1}{2\pi}\sqrt{\frac{6k}{m}}$
(4) $\frac{1}{2\pi}\sqrt{\frac{2k}{m}}$

Q12. A travelling harmonic wave is represented by the equation $y(x,\ t)=10^{-3}\sin(50t+2x)$, where x and y are in meter and t is in seconds. Which of the following is a correct statement about the wave?

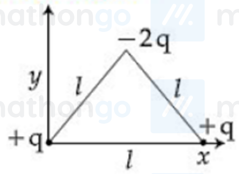
(1) The wave is propagating along the positive x - axis with speed 25 $\mathrm{m\ s^{-1}}$

(2) The wave is propagating along the positive x - axis with speed 100 $\mathrm{m\ s^{-1}}$

(3) The wave is propagating along the negative x - axis with speed 25 $\mathrm{m\ s^{-1}}$

(4) The wave is propagating along the negative x - axis with speed 100 $\mathrm{m\ s^{-1}}$

Q13. Determine the electric dipole moment of the system of three charges, placed on the vertices of an equilateral triangle, as shown in the figure:



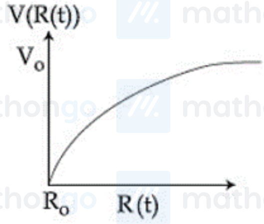
(1) $\sqrt{3}\,ql\frac{\hat{j}-\hat{i}}{\sqrt{2}}$

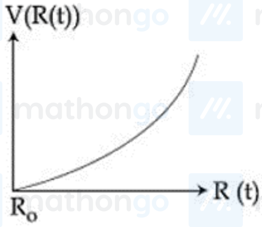
(2) $-\sqrt{3}\,ql\,\hat{j}$

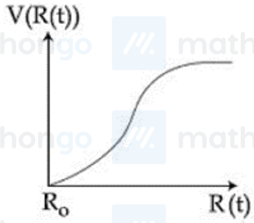
(3) $2\,ql\ \hat{j}$

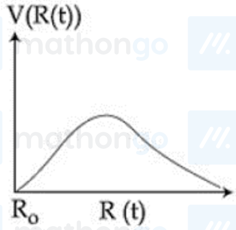
(4) $(ql)\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

Q14. There is a uniform spherically symmetric surface charge density at a distance R_0 from the origin. The charge distribution is initially at rest and starts expanding because of mutual repulsion. The figure that represents best the speed $V(R(t))$ of the distribution as a function of its instantaneous radius $R(t)$ is:

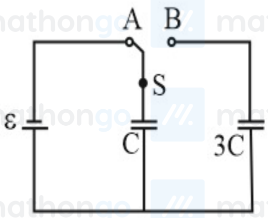
(1) 

(2) 

(3) 

(4) 

Q15. The figure shows a capacitor of capacitance C connected to a battery via a switch, having a total charge Q on it, in steady-state. When the switch S is turned from position A to position B, the energy dissipated in the circuit is



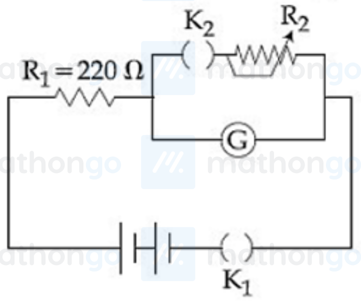
(1) $\frac{1}{8}\frac{Q^2}{C}$

(2) $\frac{3}{8}\frac{Q^2}{C}$

(3) $\frac{3}{4}\frac{Q^2}{C}$

(4) $\frac{5}{8}\frac{Q^2}{C}$

Q16. The galvanometer deflection, when key K_1 is closed but K_2 is open, equals θ_0 (see figure). On closing K_2 also and adjusting R_2 to 5Ω, the deflection in galvanometer becomes $\frac{\theta_0}{5}$. The resistance of the galvanometer is, then, given by [Neglect the internal resistance of battery]:



(1) $12\,\Omega$
(2) $22\,\Omega$
(3) $5\,\Omega$
(4) $25\,\Omega$

Q17. An ideal battery of emf $4V$ and resistance R are connected in series in the primary circuit of a potentiometer of length $1\ m$ and resistance $5\ \Omega$. The value of R, to give a potential difference of $5\ mV$ across $10\ cm$ of potentiometer wire, is:

(1) $480\,\Omega$
(2) $495\,\Omega$
(3) $395\,\Omega$
(4) $490\,\Omega$

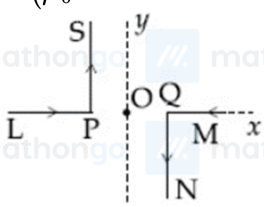
Q18. Two electric bulbs, rated at $(25\text{ W},\ 220\text{ V})$ and $(100\text{ W},\ 220\text{ V})$, are connected in series across a 220 V voltage source. If the 25 W and 100 W bulbs draw powers P_1 and P_2 respectively, then:

(1) $P_1 = 4\text{ W},\ P_2 = 16\text{ W}$
(2) $P_1 = 9\text{ W},\ P_2 = 16\text{ W}$
(3) $P_1 = 16\text{ W},\ P_2 = 9\text{ W}$
(4) $P_1 = 16\text{ W},\ P_2 = 4\text{ W}$

Q19. A proton and an α- particle (with their masses in the ratio of 1 : 4 and charges in the ratio of 1 : 2) are accelerated from rest through a potential difference V. If a uniform magnetic field (B) is set up perpendicular to their velocities, the ratio of the radii $r_p : r_\alpha$ of the circular paths described by them will be:

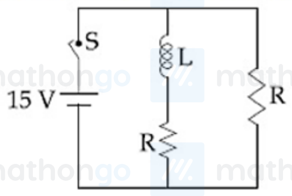
(1) $1 : 3$
(2) $1 : \sqrt{2}$
(3) $1 : 2$
(4) $1 : \sqrt{3}$

Q20. As shown in the figure, two infinitely long, identical wires are bent by 90^o and placed in such a way that the segments LP and QM are along the x - axis, while segments PS and QN are parallel to the y - axis. If $OP = OQ = 4cm$, and the magnitude of the magnetic field at O is $10^{-4}\ T$, and the two wires carry equal currents (see figure), the magnitude of the current in each wire and the direction of the magnetic field at O will be $\left(\mu_0 = 4\pi \times 10^{-7} NA^{-2}\right)$:



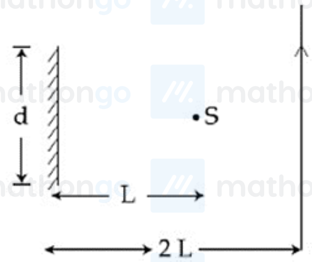
(1) 20 A, perpendicular into the page
(2) 20 A, perpendicular out of the page
(3) 40 A, perpendicualr into the page
(4) 40 A, perpendicular out of the page

Q21. In the figure shown, a circuit contains two identical resistors with resistance $R = 5\,\Omega$ and an inductance with $L = 2\,mH$. An ideal battery of $15V$ is connected in the circuit. What will be the current through the battery long after the switch is closed?



(1) 5.5 A
(2) 6 A
(3) 3 A
(4) 7.5 A

Q22. A point source of light, S is placed at a distance L in front of the center of plane mirror of width d which is hanging vertically on a wall. A man walks in front of the mirror along a line parallel to the mirror, at a distance 2L as shown below. The distance over which the man can see the image of the light source in the mirror is:

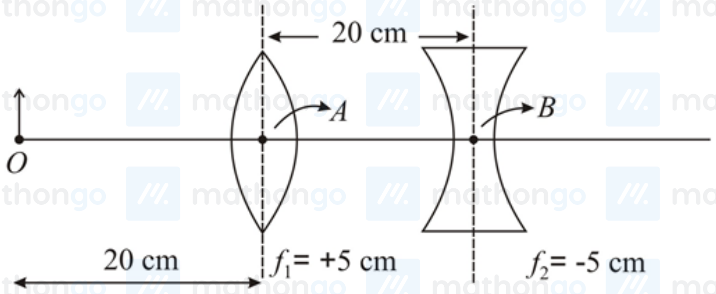


(1) $3d$
(2) $2d$
(3) d
(4) $\frac{d}{2}$

Q23. A light wave is incident normally on a glass slab of refractive index 1.5. If 4% of light gets reflected and the amplitude of the electric field of the incident light is $30\ \frac{V}{m}$, then the amplitude of the electric field for the wave propagating in the glass medium will be:

(1) $30\frac{V}{m}$
(2) $6\frac{V}{m}$
(3) $24\frac{V}{m}$
(4) $10\frac{V}{m}$

Q24. What is the position and nature of image formed by lens combination shown in figure? ($f_1,\ f_2$ are focal lengths)



(1) 40 cm from point B at right; real
(2) $\frac{20}{3}cm$ from point B at right, real
(3) 70 cm from point B at right; real
(4) 70 cm from point B at left; virtual

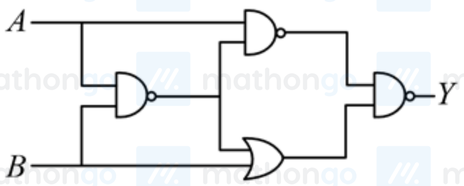
Q25. A particle A of mass m and charge q is accelerated by a potential difference of 50 V. Another particle B of mass $4m$ and charge q is accelerated by a potential difference of 2500 V. The ratio of de-Broglie wavelengths $\frac{\lambda_A}{\lambda_B}$ is close to:

(1) 0.07
(2) 10.00
(3) 4.47
(4) 14.14

Q26. A particle of mass m moves in a circular orbit in a central potential field $U(r) = \frac{1}{2}kr^2$. If Bohr's quantization conditions are applied, radii of possible orbitals and energy levels vary with quantum number n as:

(1) $r_n \propto n^2$, $E_n \propto \frac{1}{n^2}$
(2) $r_n \propto \sqrt{n}$, $E_n \propto n$
(3) $r_n \propto n$, $E_n \propto n$
(4) $r_n \propto \sqrt{n}$, $E_n \propto \frac{1}{n}$

Q27. The output of the given logic circuit is:



(1) $A\overline{B}$
(2) $\overline{A}B$
(3) $AB + \overline{AB}$
(4) $A\overline{B} + \overline{A}B$

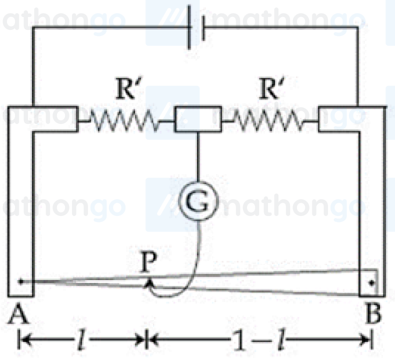
Q28. A $100V$ carrier wave is made to vary between $160\ V$ and $40\ V$ by a modulating signal. What is the modulation index?

(1) 0.3
(2) 0.6
(3) 0.4
(4) 0.5

Q29. The least count of the main scale of a screw gauge is 1 mm. The minimum number of divisions on its circular scale required to measure 5 μm diameter of a wire is:

(1) 50
(2) 100
(3) 500
(4) 200

Q30. In a meter bridge, the wire of length $1\ m$ has a non-uniform cross-section such that, the variation $\frac{dR}{dl}$ of its resistance R with length l is $\frac{dR}{dl} \propto \frac{1}{\sqrt{l}}$. Two equal resistances are connected as shown in the figure. The galvanometer has zero deflection when the jockey is at point P. What is the length AP?



(1) $0.2\ m$ (2) $0.35\ m$
(3) $0.3\ m$ (4) $0.25\ m$

Q31. What is the work function of the metal if the light of wavelength $4000\ \mathring{A}$ generates photoelectrons of velocity $6 \times 10^5\ \text{ms}^{-1}$ from it?
(Mass of electron $= 9 \times 10^{-31}$ kg, velocity of light $= 3 \times 10^8\ \text{ms}^{-1}$, Planck's constant $= 6.626 \times 10^{-34}$ Js, Charge of electron $= 6.626 \times 10^{-34}$ Js)
(1) 0.9 eV (2) 4.0 eV
(3) 3.1 eV (4) 2.1 eV

Q32. The element with Z = 120 (not yet discovered) will be a/an
(1) transition metal. (2) alkaline earth metal.
(3) alkali metal. (4) inner-transition metal.

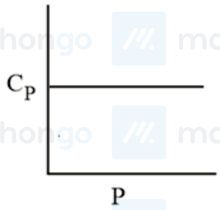
Q33. Given:

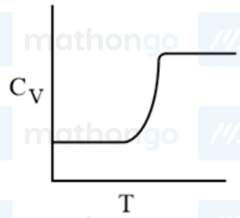
Gas	H_2	CH_4	CO_2	SO_2
Critical temperature in K	33	190	304	630

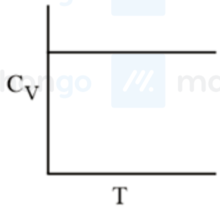
On the basis of data given above, predict which of the following gases shows the least adsorption on a definite amount of charcoal?
(1) CH_4 (2) CO_2
(3) SO_2 (4) H_2

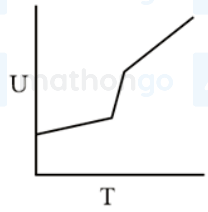
Q34. The volume of gas A is twice than that of gas B. The compressibility factor of gas A is thrice than that of gas B at same temperature. What are the pressures of the gases for equal number of moles?
(1) $2P_A = 3P_B$ (2) $P_A = 2P_B$
(3) $3P_A = 2P_B$ (4) $P_A = 3P_B$

Q35. For a diatomic ideal gas in a closed system, which of the following plots does not correctly describe the relation between various thermodynamic quantities?

(1)


(2)


(3)


(4)


Q36. In a chemical reaction, $A + 2B \overset{K}{\rightleftharpoons} 2C + D$, the initial concentration of B was 1.5 times of the concentration of A , but the equilibrium concentrations of A and B were found to be equal. The equilibrium constant (K) for the chemical reaction is:

(1) 1
(2) 4
(3) $\frac{1}{4}$
(4) 16

Q37. Two solids dissociate as follows:

$A\ (s) \rightleftharpoons B\ (g) + C\ (g);\ K_{P_1} = x\ \ atm^2$

$D\ (s) \rightleftharpoons C\ (g) + E\ (g);\ K_{P_2} = y\ \ atm^2$

The total pressure when both the solids dissociate simultaneously is:

(1) $\sqrt{x + y}$ atm
(2) $x^2 + y^2$ atm
(3) $(x + y)$ atm
(4) $2(\sqrt{x + y})$ atm

Q38. 50 mL of 0 .5 M oxalic acid is needed to neutralize 25 mL of sodium hydroxide solution. What is the amount of NaOH in 50 mL of the given sodium hydroxide solution?

(1) 2 g
(2) 4 g
(3) 1 g
(4) 8 g

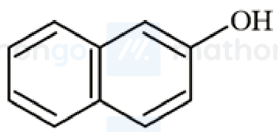
Q39. What is the hardness of a water sample (in terms of equivalents of $CaCO_3$) containing $10^{-3}M\ CaSO_4$? (Molar mass of $CaSO_4 = 136\,g\ \ mol^{-1}$)

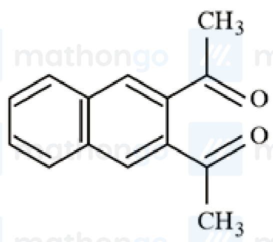
(1) 90 ppm
(2) 50 ppm
(3) 10 ppm
(4) 100 ppm

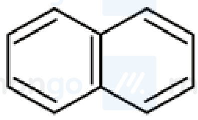
Q40. A metal on combustion in excess air forms X . X upon hydrolysis with water yields H_2O_2 and O_2 along with another product. The metal is:

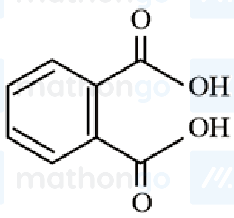
(1) Na
(2) Mg
(3) Li
(4) Rb

Q41. Among the following four aromatic compounds, which one will have the lowest melting point?

(1)


(2)


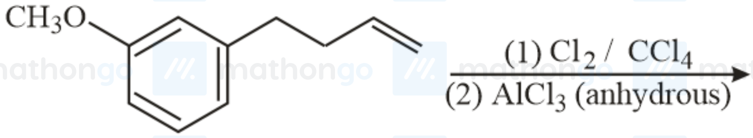
(3)


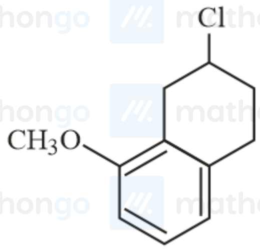
(4)


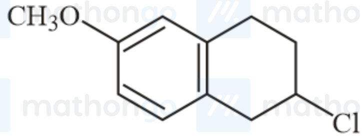
Q42. The correct order for acid strength of compounds $CH \equiv CH,\ CH_3 - C \equiv CH$ and $CH_2 = CH_2$ is as follows:

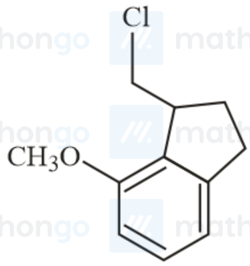
(1) $CH_3 - C \equiv CH > CH \equiv CH > CH_2 = CH_2$
(2) $HC \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2$
(3) $CH \equiv CH > CH_2 = CH_2 > CH_3 - C \equiv CH$
(4) $CH_2 - C \equiv CH > CH_2 = CH_2 > HC \equiv CH$

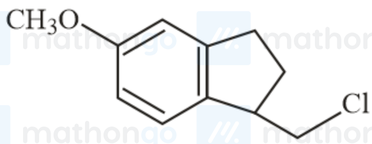
Q43. The major product of the following reaction is:



(1)


(2)


(3)


(4)


Q44. Water samples with *BOD* values of 4 ppm and 18 ppm, respectively, are:

(1) Highly polluted and Highly polluted
(2) Clean and Clean
(3) Highly polluted and Clean
(4) Clean and Highly polluted

Q45. The molecule that has minimum or no role in the formation of photochemical smog, is:

(1) N_2
(2) O_3
(3) $H_2C=O$
(4) NO

Q46. The freezing point of a 4% aqueous solution of X is equal to the freezing point of a 12% aqueous solution of Y . If the molecular weight of X is A, then the molecular weight of Y will be

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

Q47. The standard electrode potential E^{o} and its temperature coefficient $\left(\frac{dE}{dT}\right)$ for a cell are $2\,V$ and $-5\times10^{-4}\ V\,K^{-1}$ at $300\,K$, respectively. The reaction is $Zn\ (s)+Cu^{2+}\ (aq)\rightarrow Zn^{2+}\ (aq)+Cu\ (s)$. The standard reaction enthalpy (Δ_rH^{-}) at $300\,K$ in mol^{-1} is

[Use $R=8\ J\,K^{-1}\ mol^{-1}$ and $F=96{,}500\ C\ mol^{-1}$]

(1) -412.8
(2) 206.4
(3) -384.0
(4) 192.0

Q48. Decomposition of X exhibits a rate constant of 0 .05 μg/ year. How many years are required for the decomposition of 5 μg of X into 2 .5 μg?

(1) 20
(2) 40
(3) 25
(4) 50

Q49. In the Hall-Heroult process, aluminium is formed at the cathode. The cathode is made out of:

(1) Platinum (2) Carbon
(3) Copper (4) Pure aluminium

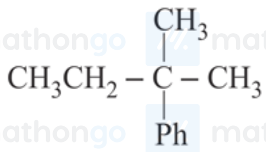
Q50. Iodine reacts with concentrated HNO_3 to yield Y along with other products. The oxidation state of iodine in Y , is:
(1) 1 (2) 5
(3) 3 (4) 7

Q51. The pair of metal ions that can give a spin only magnetic moment of 3.9 BM for the complex $[M(H_2O)_6]Cl_2$, is:
(1) Co^{2+} and Fe^{2+} (2) V^{2+} and Fe^{2+}
(3) Cr^{2+} and Mn^{2+} (4) V^{2+} and Co^{2+}

Q52. The metal's $d-$ orbitals that are directly facing the ligands in $K_3[Co(CN)_6]$ are:
(1) d_{xy}, d_{xz} and d_{yz} (2) $d_{x^2-y^2}$ and d_{z^2}
(3) d_{xy} and $d_{x^2-y^2}$ (4) d_{xz}, d_{yz} and d_{z^2}

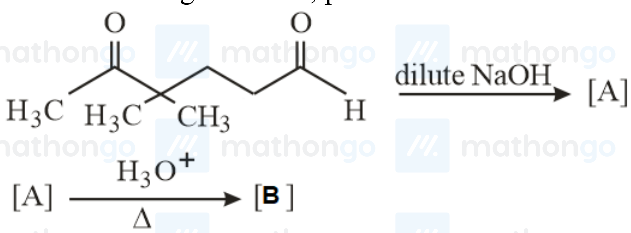
Q53. $Mn_2(CO)_{10}$ is an organometallic compound due to the presence of:
(1) $Mn-O$ bond (2) $Mn-Mn$ bond
(3) $C-O$ bond (4) $Mn-C$ bond

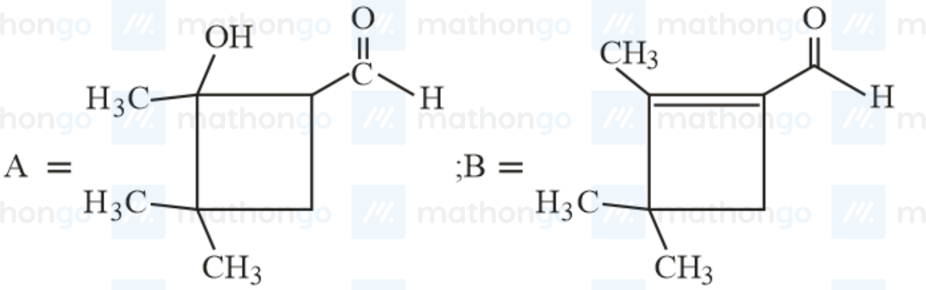
Q54.



cannot be prepared by:
(1) $\mathrm{HCHO} + \mathrm{PhCH(CH_3)\,CH_2\,MgX}$ (2) $\mathrm{PhCOCH_2\,CH_3 + CH_3\,MgX}$
(3) $\mathrm{CH_3\,CH_2\,COCH_3 + PhMgX}$ (4) $\mathrm{PhCOCH_3 + CH_3\,CH_2\,MgX}$

Q55. In the following reactions, products A and B are:



(1)


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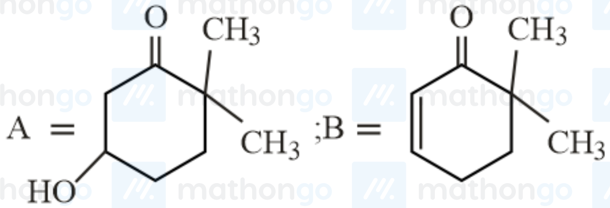
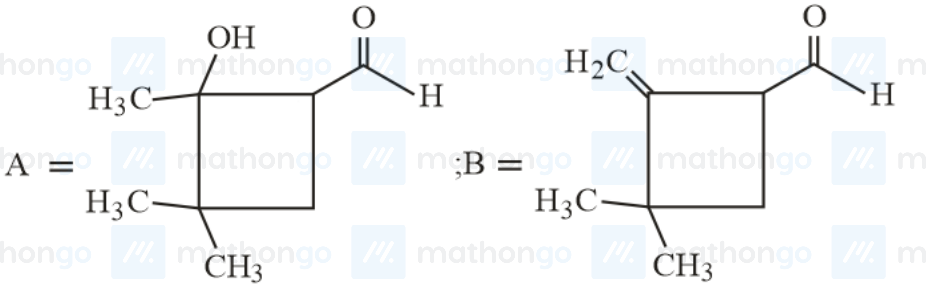
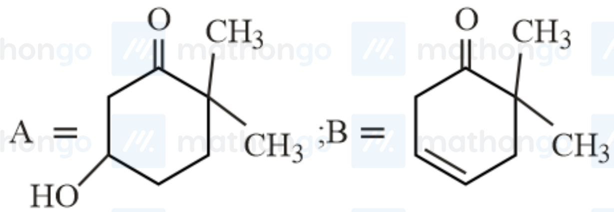
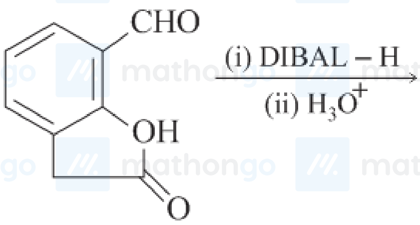


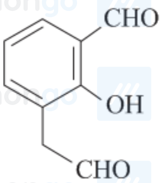
(3)


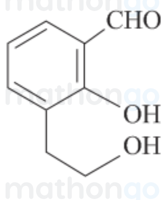
(4)


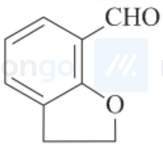
Q56.

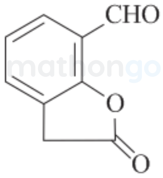


The major product of the following reaction is:

(1)


(2)


(3)


(4)


Q57. In the following reaction

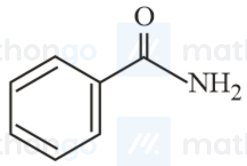
$\text{Aldehyde} + \text{Alcohol} \xrightarrow{\text{HCl}} \text{Acetal}$

Aldehyde	Alcohol
HCHO	$\mathrm{t-BuOH}$
CH_3CHO	MeOH

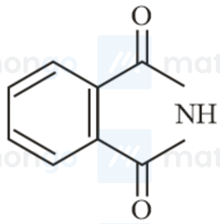
The best combination is:

(1) HCHO and MeOH
(2) CH_3CHO and $\mathrm{t-BuOH}$
(3) CH_3CHO and MeOH
(4) HCHO and t- BuOH

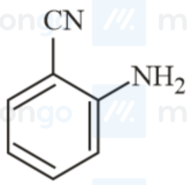
Q58. The increasing order of reactivity of the following compounds towards reaction with alkyl halides directly is:



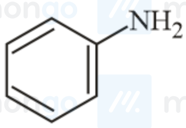
(i)



(ii)



(iii)



(iv)

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

Q59. Poly-β-hydroxybutyrate-co-β-hydroxyvalerate $(PHBV)$ is a copolymer of ______.

(1) 3− hydroxybutanoic acid and 4− hydroxypentanoic acid
(2) 3− hydroxybutanoic acid and 2− hydroxypentanoic acid
(3) 3− hydroxybutanoic acid and 3− hydroxypentanoic acid
(4) 2− hydroxybutanoic acid and 3− hydroxypentanoic acid

Q60. Among the following compounds most basic amino acid is:

(1) Lysine
(2) Asparagine
(3) Serine
(4) Histidine

Q61. If λ be the ratio of the roots of the quadratic equation in $x,\ 3m^2x^2 + m(m-4)x + 2 = 0$, then the least value of m for which $\lambda + \frac{1}{\lambda} = 1$, is :

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

Q62. If $\frac{z-\alpha}{z+\alpha}(\alpha \in R)$ is a purely imaginary number and $|z|=2$, then a value of α is :
(1) 1
(2) $\frac{1}{2}$
(3) $\sqrt{2}$
(4) 2

Q63. Let $S=\{1, 2, 3, \ldots, 100\}$, then number of non-empty subsets A of S such that the product of elements in A is even is :
(1) $2^{100}-1$
(2) $2^{50}+1$
(3) $2^{50}(2^{50}-1)$
(4) $2^{50}-1$

Q64. Consider three boxes, each containing 10 balls labelled $1, 2, \ldots, 10$. Suppose one ball is randomly drawn from each of the boxes. Denote by n_i, the label of the ball drawn from the i^{th} box, $(i=1, 2, 3)$. Then, the number of ways in which the balls can be chosen such that $n_1<n_2<n_3$ is :
(1) 240
(2) 82
(3) 120
(4) 164

Q65. Let $S_k=\frac{1+2+3+\ldots+k}{k}$. If $S_1^2+S_2^2+\ldots+S_{10}^2=\frac{5}{12}A$, then A is equal to :
(1) 301
(2) 303
(3) 156
(4) 283

Q66. The product of three consecutive terms of a $G.P.$ is 512. If 4 is added to each of the first and the second of these terms, the three terms now form an $A.P.$, then the sum of the original three terms of the given $G.P.$ is :
(1) 28
(2) 24
(3) 32
(4) 36

Q67. A ratio of the 5^{th} term from the beginning to the 5^{th} term from the end in the binomial expansion of $\left(2^{\frac{1}{3}}+\frac{1}{2(3)^{\frac{1}{3}}}\right)^{10}$ is
(1) $1:4(16)^{\frac{1}{3}}$
(2) $4(36)^{\frac{1}{3}}:1$
(3) $2(36)^{\frac{1}{3}}:1$
(4) $1:2(6)^{\frac{1}{3}}$

Q68. The maximum value of $3\cos\theta+5\sin\left(\theta-\frac{\pi}{6}\right)$ for any real value of θ is :
(1) $\sqrt{19}$
(2) $\sqrt{31}$
(3) $\frac{\sqrt{79}}{2}$
(4) $\sqrt{34}$

Q69. If the straight line $2x-3y+17=0$ is perpendicular to the line passing through the points $(7,17)$ and $(15, \beta)$, then β equals :
(1) -5
(2) $\frac{35}{3}$
(3) 5
(4) $-\frac{35}{3}$

Q70. Let C_1 and C_2 be the centres of the circles $x^2+y^2-2x-2y-2=0$ and $x^2+y^2-6x-6y+14=0$ respectively. If P and Q are the points of intersection of these circles, then the area (in sq. units) of the quadrilateral PC_1QC_2 is :

(1) 6
(2) 4
(3) 8
(4) 9

Q71. If a variable line $3x + 4y - \lambda = 0$ is such that the two circles $x^2 + y^2 - 2x - 2y + 1 = 0$ and $x^2 + y^2 - 18x - 2y + 78 = 0$ are on its opposite sides, then the set of all values of λ is the interval :
(1) $[13,\ 23]$
(2) $(23,\ 31)$
(3) $[12,\ 21]$
(4) $(2,\ 17)$

Q72. Let $P(4, -4)$ and $Q(9, 6)$ be two points on the parabola, $y^2 = 4x$ and let X be any point on the arc POQ of this parabola, where O is the vertex of this parabola, such that the area of ΔPXQ is maximum. Then this maximum area (in sq. units) is :
(1) $\frac{625}{4}$
(2) $\frac{75}{2}$
(3) $\frac{125}{4}$
(4) $\frac{125}{2}$

Q73. If the vertices of a hyperbola be at $(-2,\ 0)$ and $(2,\ 0)$ and one of its foci be at $(-3,\ 0)$, then which one of the following points does not lie on this hyperbola ?
(1) $\left(6,\ 5\sqrt{2}\right)$
(2) $\left(-6,\ 2\sqrt{10}\right)$
(3) $\left(2\sqrt{6},\ 5\right)$
(4) $\left(4,\ \sqrt{15}\right)$

Q74. $\lim\limits_{x \to \frac{\pi}{4}} \frac{\cot^3 x - \tan x}{\cos\left(x + \frac{\pi}{4}\right)}$ is
(1) $4\sqrt{2}$
(2) $8\sqrt{2}$
(3) 4
(4) 8

Q75. The Boolean expression $((p \wedge q) \vee (p \vee \sim q)) \wedge (\sim p \wedge \sim q)$ is equivalent to
(1) $p \wedge (\sim q)$
(2) $(\sim p) \wedge (\sim q)$
(3) $p \vee (\sim q)$
(4) $p \wedge q$

Q76. If the sum of the deviations of 50 observations from 30 is 50, then the mean of these observations is :
(1) 30
(2) 51
(3) 50
(4) 31

Q77. Let $P = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 9 & 3 & 1 \end{bmatrix}$ and $Q = [q_{ij}]$ be two 3×3 matrices such that $Q - P^5 = I_3$. Then $\frac{q_{21} + q_{31}}{q_{32}}$ is equal to :
(1) 10
(2) 9
(3) 15
(4) 135

Q78. An ordered pair $(\alpha,\ \beta)$ for which the system of linear equations
$(1 + \alpha)x + \beta y + z = 2$
$\alpha x + (1 + \beta)y + z = 3$
$\alpha x + \beta y + 2z = 2$ has a unique solution, is :
(1) $(-3,\ 1)$
(2) $(1,\ -3)$
(3) $(2,\ 4)$
(4) $(-4,\ 2)$

Q79. Considering only the principal values of inverse functions, the set
$A=\left\{x\geq 0\ :\ \tan^{-1}(2x)+\tan^{-1}(3x)=\frac{\pi}{4}\right\}$
(1) Is an empty set
(2) Contains more than two elements
(3) Contains two elements
(4) Is a singleton

Q80. Let S be the set of all points in $(-\pi,\pi)$ at which the function, $f(x)=\min\{\sin x,\ \cos x\}$ is not differentiable. Then S is a subset of which of the following?
(1) $\left\{-\frac{3\pi}{4},-\frac{\pi}{2},\frac{\pi}{2},\frac{3\pi}{4}\right\}$
(2) $\left\{-\frac{3\pi}{4},-\frac{\pi}{4},\frac{3\pi}{4},\frac{\pi}{4}\right\}$
(3) $\left\{-\frac{\pi}{4},0,\frac{\pi}{4}\right\}$
(4) $\left\{-\frac{\pi}{2},-\frac{\pi}{4},\ \frac{\pi}{4},\ \frac{\pi}{2}\right\}$

Q81. For $x>1$, if $(2x)^{2y}=4e^{2x-2y}$, then $\left(1+\log_e 2x\right)^2\ \frac{dy}{dx}$ is equal to
(1) $\log_e 2x$
(2) $\frac{x\log_e 2x-\log_e 2}{x}$
(3) $x\log_e 2x$
(4) $\frac{x\log_e 2x+\log_e 2}{x}$

Q82. The maximum area (in sq. units) of a rectangle having its base on the $x-$ axis and its other two vertices on the parabola, $y=12-x^2$ such that the rectangle lies inside the parabola, is :
(1) $20\sqrt{2}$
(2) 32
(3) 36
(4) $18\sqrt{3}$

Q83. The integral $\int\cos(\ln x)dx$, is equal to
(1) $\frac{x}{2}(\cos(\ln x)-\sin(\ln x))+C$
(2) $x(\cos(\ln x)-\sin(\ln x))+C$
(3) $x(\cos(\ln x)+\sin(\ln x))+C$
(4) $\frac{x}{2}(\cos(\ln x)+\sin(\ln x))+C$

Q84. Let f and g be continuous functions on $[0,a]$ such that $f(x)=f(a-x)$ and $g(x)+g(a-x)=4$, then $\int_0^a f(x)g(x)dx$ is equal to
(1) $\int_0^a f(x)dx$
(2) $-3\int_0^a f(x)dx$
(3) $4\int_0^a f(x)dx$
(4) $2\int_0^a f(x)dx$

Q85. The area (in sq. units) of the region bounded by the parabola, $y=x^2+2$ and the lines, $y=x+1$, $x=0$ and $x=3$, is
(1) $\frac{17}{4}$
(2) $\frac{21}{2}$
(3) $\frac{15}{2}$
(4) $\frac{15}{4}$

Q86. Let $y=y(x)$ be the solution of the differential equation, $x\frac{dy}{dx}+y=x\log_e x,\ (x>1)$. If $2y(2)=\log_e 4-1$, then $y(e)$ is equal to
(1) $-\frac{e}{2}$
(2) $\frac{e}{4}$
(3) $-\frac{e^2}{2}$
(4) $\frac{e^2}{4}$

Q87. The sum of the distinct real values of μ for which the vectors $\mu\hat{i}+\hat{j}+\hat{k},\ \hat{i}+\mu\hat{j}+\hat{k},\ \hat{i}+\hat{j}+\mu\hat{k}$ are co-planar, is
(1) 0
(2) -1
(3) 1
(4) 2

Q88. A tetrahedron has vertices $P(1,\ 2,\ 1),\ Q(2,\ 1,\ 3),\ R(-1,\ 1,\ 2)$ and $O(0,\ 0,\ 0)$. The angle between the faces OPQ and PQR is

(1) $\cos^{-1}\left(\frac{7}{31}\right)$
(2) $\cos^{-1}\left(\frac{17}{31}\right)$
(3) $\cos^{-1}\left(\frac{19}{35}\right)$
(4) $\cos^{-1}\left(\frac{9}{35}\right)$

Q89. The perpendicular distance from the origin to the plane containing the two lines, $\frac{x+2}{3}=\frac{y-2}{5}=\frac{z+5}{7}$ and $\frac{x-1}{1}=\frac{y-4}{4}=\frac{z+4}{7}$, is

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

Q90. In a random experiment, a fair die is rolled until two fours are obtained in succession. The probability that the experiment will end in the fifth throw of the die is equal to :

(1) $\frac{150}{6^5}$
(2) $\frac{175}{6^5}$
(3) $\frac{225}{6^5}$
(4) $\frac{200}{6^5}$

ANSWER KEYS

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