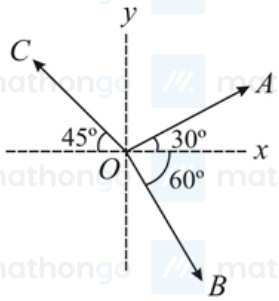
Q1. The magnitude of vectors $\overrightarrow{OA},\ \overrightarrow{OB}$ and $\overrightarrow{OC}$ in the given figure are equal. The direction of $\overrightarrow{OA}+\overrightarrow{OB}-\overrightarrow{OC}$ with $x-$axis will be:



(1) $\tan^{-1}\frac{\left(\sqrt{3}-1+\sqrt{2}\right)}{\left(1+\sqrt{3}-\sqrt{2}\right)}$

(2) $\tan^{-1}\frac{\left(1-\sqrt{3}-\sqrt{2}\right)}{\left(1+\sqrt{3}+\sqrt{2}\right)}$

(3) $\tan^{-1}\frac{\left(\sqrt{3}-1+\sqrt{2}\right)}{\left(1-\sqrt{3}+\sqrt{2}\right)}$

(4) $\tan^{-1}\frac{\left(1+\sqrt{3}-\sqrt{2}\right)}{\left(1-\sqrt{3}-\sqrt{2}\right)}$

Q2. If $E,\ L,\ M$ and G denote the quantities as energy, angular momentum, mass and constant of gravitation respectively, then the dimensions of P in the formula $P=EL^2M^{-5}G^{-2}$ are:

(1) $\left[\mathrm{M^1L^1\ T^{-2}}\right]$

(2) $\left[\mathrm{M^0\ L^1\ T^0}\right]$

(3) $\left[\mathrm{M^{-1}L^{-1}T^2}\right]$

(4) $\left[\mathrm{M^0\ L^0\ T^0}\right]$

Q3. The initial mass of a rocket is $1000\ \mathrm{kg}$. Calculate at what rate the fuel should be burnt so that the rocket is given an acceleration of, $20\ \mathrm{m\ s^{-2}}$. The gases come out at a relative speed of $500\ \mathrm{m\ s^{-1}}$, with respect to the rocket: $\left[\text{Use } g=10\ \mathrm{m\ s^{-2}}\right]$

(1) $10\ \mathrm{kg\ s^{-1}}$

(2) $60\ \mathrm{kg\ s^{-1}}$

(3) $500\ \mathrm{kg\ s^{-1}}$

(4) $6.0\times10^2\ \mathrm{kg\ s^{-1}}$

Q4. Inside a uniform spherical shell :

(a) The gravitational field is zero.

(b) The gravitational potential is zero.

(c) The gravitational field is the same everywhere.

(d) The gravitation potential is the same everywhere.

(e) All the above.

Choose the most appropriate answer from the options given below:

(1) (a), (c) and (d) only

(2) (a), (b) and (c) only

(3) (b), (c) and (d) only

(4) (e) only

Q5. Two narrow bores of diameter $5.0\ \mathrm{mm}$ and $8.0\ \mathrm{mm}$ are joined together to form a $U-$shaped tube open at both ends. If this $U-$tube contains water, what is the difference in the level of two limbs of the tube.

[Take surface tension of water $T=7.3\times10^{-2}\ \mathrm{N\ m^{-1}}$, angle of contact $=0,\ g=10\ \mathrm{m\ s^{-2}}$ and density of water$=1.0\times10^3\ \mathrm{kg\ m^{-3}}$]

(1) $5.34\ \mathrm{mm}$

(2) $3.62\ \mathrm{mm}$

(3) $2.19\ \mathrm{mm}$

(4) $4.97\ \mathrm{mm}$

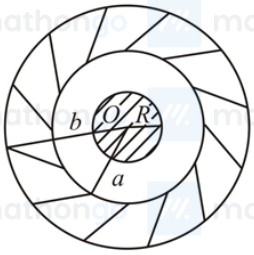
Q6. An electric appliance supplies 6000 J min^{-1}, heat to the system. If the system delivers a power of 90 W. How long it would take to increase the internal energy by 2.5×10^3 J?

(1) 2.5×10^1 s
(2) 2.5×10^2 s
(3) 2.4×10^3 s
(4) 4.1×10^1 s

Q7. The R.M.S. speeds of the molecules of Hydrogen, Oxygen, and Carbon dioxide at the same temperature are v_{H}, v_{O} and v_{C} respectively, then:

(1) $v_{\text{C}} > v_{\text{O}} > v_{\text{H}}$
(2) $v_{\text{H}} = v_{\text{O}} > v_{\text{C}}$
(3) $v_{\text{H}} > v_{\text{O}} > v_{\text{C}}$
(4) $v_{\text{H}} = v_{\text{O}} = v_{\text{C}}$

Q8. A solid metal sphere of radius R having charge q is enclosed inside the concentric spherical shell of inner radius a and outer radius b as shown in the figure. The approximate variation electric field $\vec{E}$, as a function of distance r, from centre O, is given by:



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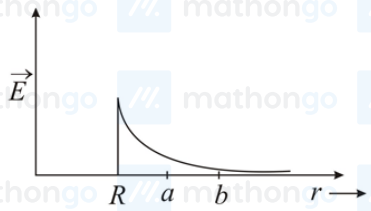

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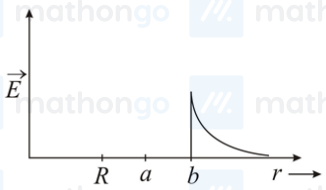
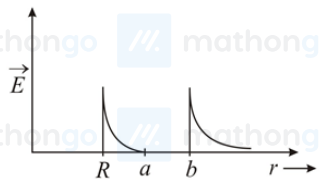
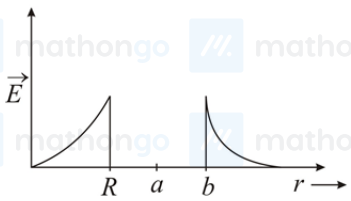


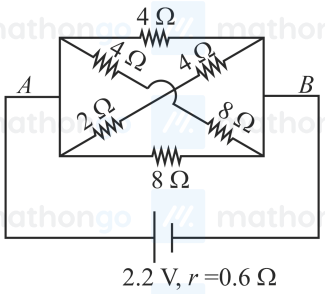
(3)


(4)


Q9. The material filled between the plates of a parallel plate capacitor has resistivity 200 Ω m. The value of capacitance of the capacitor is 2 pF. If a potential difference of 40 V is applied across the plates of the capacitor, then the value of leakage current flowing out of the capacitor is: (given the value of relative permittivity of material is 50)

(1) 0.9 mA
(2) 9.0 mA
(3) 9.0 μA
(4) 0.9 μA

Q10. In the given figure, the emf of the cell is 2.2 V and if internal resistance is 0.6 Ω. Calculate the power dissipated in the whole circuit:



(1) 1.32 W (2) 4 .4 W
(3) 0. 65 W (4) 2. 2 W

Q11. What equal length of an iron wire and a copper-nickel alloy wire, each of 2 mm diameter connected parallel to give an equivalent resistance of 3 Ω?
(Given resistivities of iron and copper-nickel alloy wire are 12 μΩ cm and 51 μΩ cm respectively)
(1) 97 m (2) 110 m
(3) 90 m (4) 82 m

Q12. The fractional change in the magnetic field intensity at a distance r from centre on the axis of current carrying coil of radius a to the magnetic field intensity at the centre of the same coil is: (Take $\mathrm{r} < \mathrm{a}$)
(1) $\frac{2}{3}\frac{a^2}{r^2}$ (2) $\frac{3}{2}\frac{a^2}{r^2}$
(3) $\frac{3}{2}\frac{r^2}{a^2}$ (4) $\frac{2}{3}\frac{r^2}{a^2}$

Q13. A series LCR circuit driven by 300 V at a frequency of 50 Hz contains a resistance $\mathrm{R} = 3\ \mathrm{k}\Omega$, an inductor of inductive reactance $\mathrm{X_L} = 250\pi\ \Omega$ and an unknown capacitor. The value of capacitance to maximise the average power should be:
$\left(\text{take } \pi^2 = 10\right)$
(1) 400 μF (2) 4 μF
(3) 40 μF (4) 25 μF

Q14. An inductor coil stores 64 J of magnetic field energy and dissipates energy at the rate of 640 W when a current of 8 A is passed through it. If this coil is joined across an ideal battery, find the time constant of the circuit (in s).
(1) 0. 4 (2) 0. 2
(3) 0. 125 (4) 0. 8

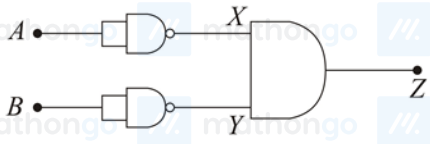
Q15. Car B overtakes another car A at a relative speed of 40 $\mathrm{m\ s^{-1}}$. How fast will the image of car B appear to move in the mirror of focal length 10 cm fitted in car A, when the car B is 1. 9 m away from the car A?
(1) 0. 1 $\mathrm{m\ s^{-1}}$ (2) 0. 2 $\mathrm{m\ s^{-1}}$
(3) 40 $\mathrm{m\ s^{-1}}$ (4) 4 $\mathrm{m\ s^{-1}}$

Q16. In a photoelectric experiment, ultraviolet light of wavelength 280 nm is used with lithium cathode having work function $\phi = 2.5$ eV. If the wavelength of incident light is switched to 400 nm, find out the change in the stopping potential.
$\left(\mathrm{h} = 6.63 \times 10^{-34}\ \mathrm{J\ s},\ \mathrm{c} = 3 \times 10^{8}\ \mathrm{m\ s^{-1}}\right)$

(1) $1.1\ \text{V}$ (2) $0.6\ \text{V}$
(3) $1.3\ \text{V}$ (4) $1.9\ \text{V}$

Q17. A particular hydrogen like ion emits radiation of frequency 2.92×10^{15} Hz when it makes transition from $\text{n} = 3$ to $\text{n} = 1$. The frequency in Hz of radiation emitted in transition from $\text{n} = 2$ to $\text{n} = 1$ will be:
(1) 6.57×10^{15} (2) 2.46×10^{15}
(3) 0.44×10^{15} (4) 4.38×10^{15}

Q18. Identify the logic operation carried out by the given circuit:



(1) OR (2) AND
(3) NAND (4) NOR

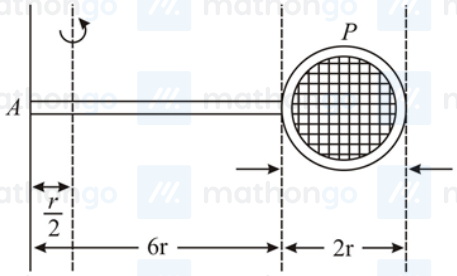
Q19. **Statement I:** By doping silicon semiconductors with pentavalent material, the electrons density increases.
Statement II: The $n-$type of semiconductor has a net negative charge.
In the above statements, choose the most appropriate answer from the options given below:
(1) Both Statement I and Statement II are false. (2) Statement I is true but Statement II is false.
(3) Statement I is false but Statement II is true. (4) Both Statement I and Statement II are true.

Q20. In a Screw Gauge, fifth division of the circular scale coincides with the reference line when the ratchet is closed. There are 50 divisions on the circular scale, and the main scale moves by $0.5\ \text{mm}$ on a complete rotation. For a particular observation the reading on the main scale is $5\ \text{mm}$ and the 20^{th} division of the circular scale coincides with reference line. Calculate the true reading.
(1) $5.20\ \text{mm}$ (2) $5.00\ \text{mm}$
(3) $5.15\ \text{mm}$ (4) $5.25\ \text{mm}$

Q21. Two spherical balls having equal masses with radius of $5\ \text{cm}$ each are thrown upwards along the same vertical direction at an interval of 3 s with the same initial velocity of $35\ \text{m s}^{-1}$, then these balls collide at a height of _____m,
(take $\text{g} = 10\ \text{m s}^{-2}$)

Q22. A uniform chain of length 3 m and mass $3\ \text{kg}$ overhangs a smooth table with 2 m laying on the table. If K is the kinetic energy of the chain in J as it completely slips off the table, then the value of K is
$\left(\text{Take g} = 10\ \text{m s}^{-2}\right)$

Q23. Consider a badminton racket with length scales as shown in the figure.



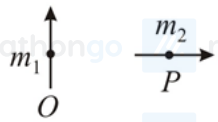
If the mass of the linear and circular portions of the badminton racket are same (M) and the mass of the threads are negligible, the moment of inertia of the racket about an axis perpendicular to the handle and in the plane of the ring at, $\frac{r}{2}$ distance from the end A of the handle will be _____Mr^2.

Q24. A soap bubble of the radius $3\ \text{cm}$ is formed inside another soap bubble of radius, $6\ \text{cm}$. The radius of an equivalent soap bubble that has the same excess pressure as inside the smaller bubble with respect to the atmospheric pressure is____cm.

Q25. Two travelling waves produces a standing wave represented by equation.
$y = (1.0\ \text{mm}) \cos\left[\left(1.57\ \text{cm}^{-1}\right)x\right]\ \sin\left[\left(78.5\ \text{s}^{-1}\right)\ \text{t}\right]$. The node closest to the origin in the region $x > 0$ will be at $x =$..... (in cm).

Q26. A source and a detector move away from each other in absence of wind with a speed of $20\ \text{m s}^{-1}$, with respect to the ground. If the detector detects a frequency of $1800\ \text{Hz}$ of the sound coming from the source, then the original frequency of source considering the speed of sound in the air $340\ \text{m s}^{-1}$ will be _____ Hz.

Q27. Two short magnetic dipoles m_1 and m_2 each having magnetic moment of $1\ \text{A m}^2$ are placed at point O and P respectively. The distance between OP is $1\ \text{m}$. The torque experienced by the magnetic dipole m_2 due to the presence of m_1 is _____ $\times 10^{-7}\text{N m}$



Q28. The electric field in a plane electromagnetic wave is given by
$\vec{\text{E}} = 200 \cos\left[\left(0.5 \times 10^3\ \text{m}^{-1}\right)x - \left(1.5 \times 10^{11}\ \text{rad s}^{-1}\right)t\right]\ \text{V m}^{-1}\ \hat{\text{j}}$.
If this wave falls normally on a perfectly reflecting surface having an area of $100\ \text{cm}^2$. If the radiation pressure exerted by the E.M. wave on the surface during a $10\ \text{min}$ exposure is $\frac{k}{10^9}\ \text{N m}^{-2}$. Find the value of k

Q29. White light is passed through a double slit and interference is observed on a screen $1.5\ \text{m}$ away. The separation between the slits is $0.3\ \text{mm}$. The first violet and red fringes are formed $2.0\ \text{mm}$ and $3.5\ \text{mm}$ away from the central white fringes. The difference in wavelengths of red and violet light is (in nm).

Q30. An amplitude-modulated wave is represented by, $C_m(t) = 10(1 + 0.2\cos 12560t)\sin(111 \times 10^4 t)\ \text{V}$. The modulating frequency in kHz will be

Q31. Given below are two statements :

Statement I : According to Bohr's model of an atom, qualitatively the magnitude of velocity of electron increases with decrease in positive charges on the nucleus as there is no strong hold on the electron by the nucleus.

Statement II : According to Bohr's model of an atom, qualitatively the magnitude of velocity of electron increases with decrease in principle quantum number.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is false but Statement II is true
(2) Statement I is true but Statement II is false
(3) Both Statement I and Statement II are false
(4) Both Statement I and Statement II are true

Q32. Given below are two statements:

Statement I : In the titration between strong acid and weak base methyl orange is suitable as an indicator.

Statement II : For titration of acetic acid with NaOH phenolphthalein is not a suitable indicator.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is false but Statement II is true
(2) Both Statement I and Statement II are true
(3) Both Statement I and Statement II are false
(4) Statement I is true but Statement II is false

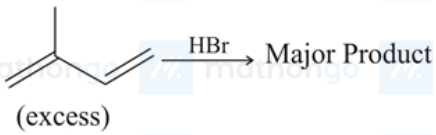
Q33. Which one of the following methods is most suitable for preparing deionized water?

(1) Synthetic resin method
(2) Calgon's method
(3) Clark's method
(4) Permutit method

Q34. What are the products formed in sequence when excess of CO_2 is passed in slaked lime?

(1) $CaO, CaCO_3$
(2) $Ca(HCO_3)_2, CaCO_3$
(3) $CaCO_3, Ca(HCO_3)_2$
(4) $CaO, Ca(HCO_3)_2$

Q35. The major product formed in the following reaction is:



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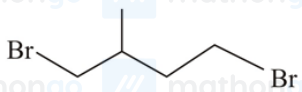

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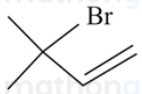

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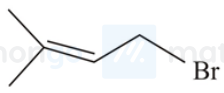

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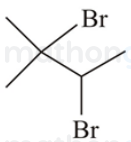
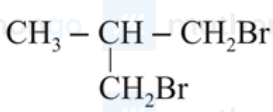
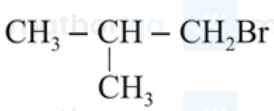
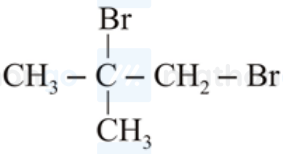
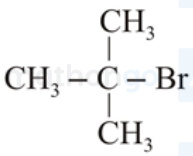


Q36. Excess of isobutane on reaction with Br_2 in presence of light at $125^\circ C$ gives which one of the following, as the major product?

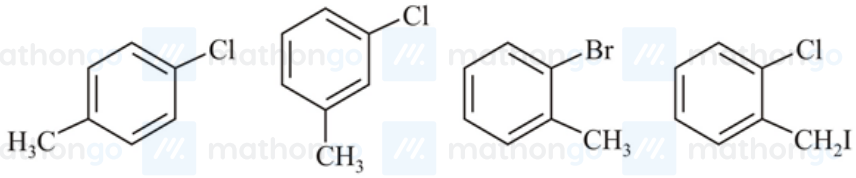
(1) 

(2) 

(3) 

(4) 

Q37. Among the following compounds I – IV, which one forms a yellow precipitate on reacting sequentially with (i) NaOH (ii) dil. HNO_3 (iii) $AgNO_3$?



I II III IV

(1) III (2) II

(3) I (4) IV

Q38. The conversion of hydroxyapatite occurs due to presence of F^- ions in water. The correct formula of hydroxyapatite is:

(1) $[Ca_3(PO_4)_2 \cdot CaF_2]$ (2) $[3\,Ca_3(PO_4)_2 \cdot Ca(OH)_2]$

(3) $[3\,Ca_3(PO_4)_2 \cdot CaF_2]$ (4) $[3\,Ca(OH)_2 \cdot CaF_2]$

Q39. Given below are two statements:

Statement I : Frenkel defects are vacancy as well as interstitial defects.

Statement II : Frenkel defect leads to colour in ionic solids due to presence of F-centres.

Choose the most appropriate answer for the statements from the options given below:

(1) Statement I is false but Statement II is true (2) Both Statement I and Statement II are false

(3) Statement I is true but Statement II is false (4) Both Statement I and Statement II are true

Q40. Given below are two statements:

Statement I : The limiting molar conductivity of KCl (strong electrolyte) is higher compared to that of CH_3COOH (weak electrolyte).

Statement II : Molar conductivity decreases with decrease in concentration of electrolyte.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is false but Statement II is true (2) Both Statement I and Statement II are true

(3) Statement I is true but Statement II is false (4) Both Statement I and Statement II are false

Q41. Which one of the following is correct for the adsorption of a gas at a given temperature on a solid surface?

(1) $\Delta H > 0, \Delta S > 0$ (2) $\Delta H < 0, \Delta S > 0$

(3) $\Delta H > 0, \Delta S < 0$ (4) $\Delta H < 0, \Delta S < 0$

Q42. Given below are two statements.

Statement I: The choice of reducing agents for metals extraction can be made by using the Ellingham diagram, a plot of ΔG vs temperature.

Statement II: The value of ΔS increases from left to right in the Ellingham diagram.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is false but Statement II is true
(2) Both Statement I and Statement II are true
(3) Statement I is true but Statement II is false
(4) Both Statenent I and Statement II are false

Q43. The incorrect statement is:

(1) F_2 is a stronger oxidizing agent than Cl_2 in aqueous solution.
(2) On hydrolysis ClF forms HOCl and HF.
(3) Cl_2 is more reactive than ClF.
(4) F_2 is more reactive than ClF.

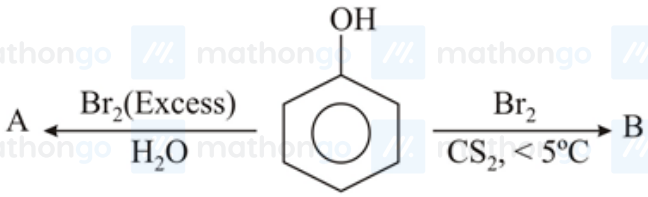
Q44. Which one of the following when dissolved in water gives coloured solution in nitrogen atmosphere?

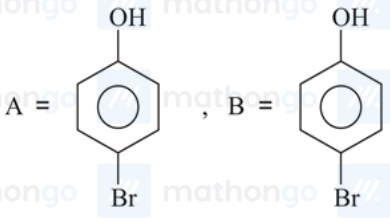
(1) Cu_2Cl_2
(2) $ZnCl_2$
(3) $CuCl_2$
(4) AgCl

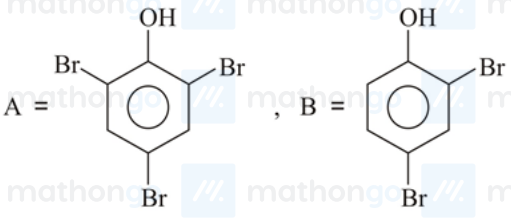
Q45. Which one of the following complexes is violet in colour?

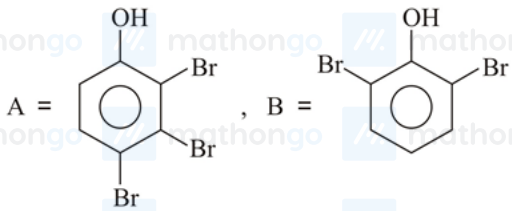
(1) $Fe_4[Fe(CN)_6]_3 \cdot H_2O$
(2) $[Fe(CN)_5NOS]^{4-}$
(3) $[Fe(SCN)_6]^{4-}$
(4) $[Fe(CN)_6]^{4-}$

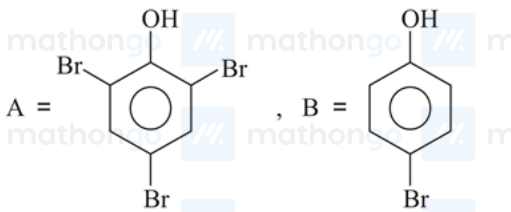
Q46. The correct options for the products A and B of the following reactions are:



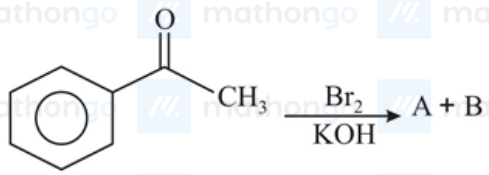
(1) 

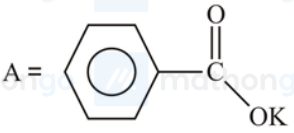
(2) 

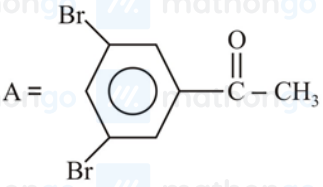
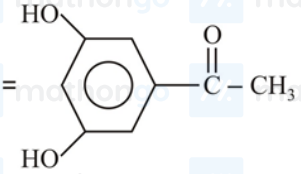
(3) 

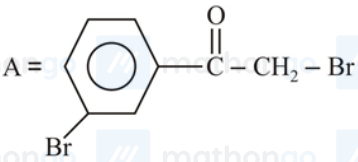
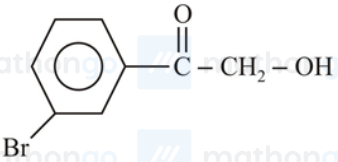
(4) 

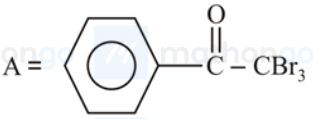
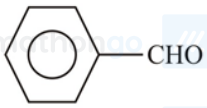
Q47. The major products formed in the following reaction sequence A and B are:



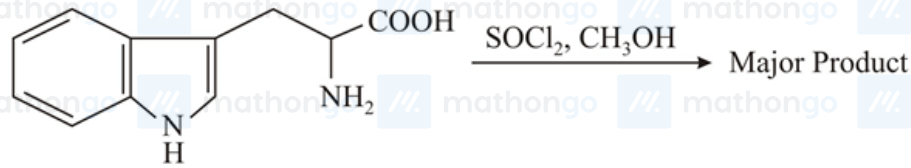
(1) A =  , B = $CHBr_3$

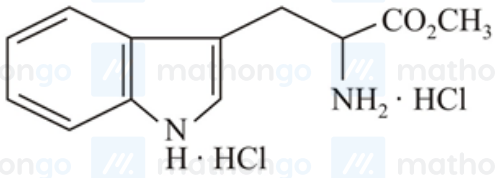
(2) A =  , B = 

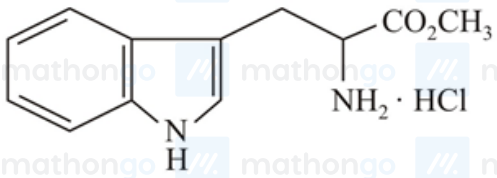
(3) A =  , B = 

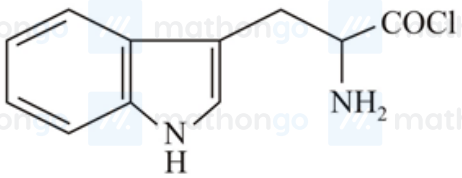
(4) A =  , B = 

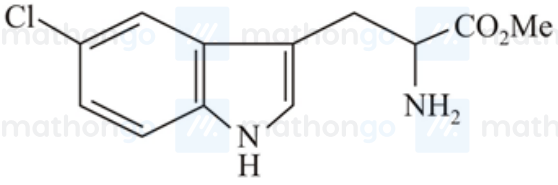
Q48. The major product formed in the following reaction is:



(1) 

(2) 

(3) 

(4) 

Q49. The correct sequential addition of reagents in the preparation of 3−nitrobenzoic acid from benzene is:

(1) Br_2 / $AlBr_3$, HNO_3 /H_2SO_4, Mg / ether, CO_2, H_3O^+
(2) Br_2 / $AlBr_3$, $NaCN$, H_3O^+, HNO_3 /H_2SO_4
(3) Br_2 / $AlBr_3$, HNO_3 /H_2SO_4, $NaCN$, H_3O^+
(4) HNO_3 /H_2SO_4, Br_2 / $AlBr_3$, Mg / ether, CO_2, H_3O^+

Q50. The polymer formed on heating Novolac with formaldehyde is:
(1) Polyester
(2) Bakelite
(3) Nylon- 6, 6
(4) Melamine

Q51. An aqueous KCl solution of density $1.20\ g\ mL^{-1}$ has a molality of $3.30\ mol\ kg^{-1}$. The molarity of the solution in $molL^{-1}$ is____.(The Nearest integer)
[Molar mass of $KCl = 74.5\ g$]

Q52. AB_3 is an interhalogen T-shaped molecule. The number of lone pairs of electrons on A is (Integer answer)

Q53. The Born-Haber cycle for KCl is evaluated with the following data:
$\Delta_f H^\Theta$ for $KCl = -436.7\,kJmol^{-1}$; $\Delta_{sub}H^\Theta$ for $K = 89.2\,kJmol^{-1}$;
$\Delta_{ionization}\,H^\Theta$ for $K = 419.0\,kJ\ mol^{-1}$; $\Delta_{electron\ gain}\,H^\Theta$ for $Cl_{(g)} = -348.6\,kJmol^{-1}$
$\Delta_{bond}\,H^\Theta$ for $Cl_2 = 243.0\,kJmol^{-1}$
The magnitude of lattice enthalpy of KCl in $kJmol^{-1}$ is (Nearest integer)

Q54. The OH^- concentration in a mixture of $5.0\ mL$ of $0.0504\ M\ NH_4Cl$ and $2\ mL$ of $0.0210\ M\ NH_3$ solution is $x \times 10^{-6}$ M. The value of x is (Nearest integer) [Given $K_w = 1 \times 10^{-14}$ and $K_b = 1.8 \times 10^{-5}$]

Q55. The ratio of number of water molecules in Mohr's salt and potash alum is $\times 10^{-1}$. (Integer answer)

Q56. Of the following four aqueous solutions, the total number of those solutions whose freezing point is lower than that of $0.10\,MC_2H_5OH$ is (Integer answer)
(i) $0.10M\ Ba_3(PO_4)_2$
(ii) $0.10M\ Na_2SO_4$
(iii) $0.10M\ KCl$
(iv) $0.10M\ Li_3PO_4$

Q57. These are physical properties of an element
(A) Sublimation enthalpy
(B) Ionisation enthalpy
(C) Hydration enthalpy
(D) Electron gain enthalpy
The total number of above properties that affect the reduction potential is (Integer answer)

Q58. The following data was obtained for chemical reaction given below at 975 K.
$2NO_{(g)} + 2H_{2(g)} \rightarrow N_{2(g)} + 2H_2O_{(g)}$

	$[NO]$	$[H_2]$	Rate
	$mol\ L^{-1}$	$mol\ L^{-1}$	$molL^{-1}\ s^{-1}$
(A)	8×10^{-5}	8×10^{-5}	7×10^{-9}
(B)	24×10^{-5}	8×10^{-5}	2.1×10^{-8}
(C)	24×10^{-5}	32×10^{-5}	8.4×10^{-8}

The order of the reaction with respect to NO_____ is [Integer answer]

Q59. The number of 4f electrons in the ground state electronic configuration of Gd^{2+} is [Atomic number of $Gd = 64$]

Q60. The total number of negative charge in the tetrapeptide, Gly-Glu-Asp-Tyr, at pH 12. 5 will be_____ (Integer answer)

Q61. The equation $arg\left(\frac{z-1}{z+1}\right) = \frac{\pi}{4}$ represents a circle with:

(1) centre at $(0, 0)$ and radius $\sqrt{2}$
(2) centre at $(0, 1)$ and radius 2
(3) centre at $(0, -1)$ and radius $\sqrt{2}$
(4) centre at $(0, 1)$ and radius $\sqrt{2}$

Q62. The sum of the series $\frac{1}{x+1} + \frac{2}{x^2+1} + \frac{2^2}{x^4+1} + \ldots + \frac{2^{100}}{x^{2^{100}}+1}$ when $x = 2$ is:

(1) $1 - \frac{2^{101}}{4^{101}-1}$
(2) $1 + \frac{2^{101}}{4^{101}-1}$
(3) $1 + \frac{2^{100}}{4^{101}-1}$
(4) $1 - \frac{2^{100}}{4^{201}-1}$

Q63. If the sum of an infinite GP, $a, ar, ar^2, ar^3, \ldots$ is 15 and the sum of the squares of its each term is 150, then the sum of $ar^2, ar^4, ar^6, \ldots$ is:

(1) $\frac{25}{2}$
(2) $\frac{9}{2}$
(3) $\frac{1}{2}$
(4) $\frac{5}{2}$

Q64. If ${}^{20}C_r$ is the co-efficient of x^r in the expansion of $(1 + x)^{20}$, then the value of $\sum_{r=0}^{20} r^2\left({}^{20}C_r\right)$ is equal to:

(1) 420×2^{18}
(2) 380×2^{18}
(3) 380×219
(4) 420×2^{19}

Q65. The sum of solutions of the equation $\frac{\cos x}{1+\sin x} = |\tan 2x|,\ x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right) - \left\{-\frac{\pi}{4}, \frac{\pi}{4}\right\}$ is:

(1) $\frac{\pi}{10}$
(2) $-\frac{7\pi}{30}$
(3) $-\frac{\pi}{15}$
(4) $-\frac{11\pi}{30}$

Q66. Let ABC be a triangle with $A(-3, 1)$ and $\angle ACB = \theta, 0 < \theta < \frac{\pi}{2}$. If the equation of the median through B is $2x + y - 3 = 0$ and the equation of angle bisector of C is $7x - 4y - 1 = 0$, then $\tan\theta$ is equal to:

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

Q67. If a line along a chord of the circle $4x^2 + 4y^2 + 120x + 675 = 0$, passes through the point $(-30, 0)$ and is tangent to the parabola $y^2 = 30x$, then the length of this chord is:

(1) 5
(2) 7
(3) $3\sqrt{5}$
(4) $5\sqrt{3}$

Q68. On the ellipse $\frac{x^2}{8} + \frac{y^2}{4} = 1$, let P be a point in the second quadrant such that the tangent at P to the ellipse is perpendicular to the line $x + 2y = 0$. Let S and S′ be the foci of the ellipse and e be its eccentricity. If A is the

area of the triangle SPS′, then the value of $\left(5-e^2\right)\cdot A$ is

(1) 12 (2) 6

(3) 14 (4) 24

Q69. If the truth value of the Boolean expression $((p \vee q) \wedge (q \rightarrow r) \wedge (\sim r)) \rightarrow (p \wedge q)$ is false, then the truth values of the statements $p,\ q,\ r$ respectively can be:

(1) FTF (2) TFF

(3) TFT (4) FFT

Q70. The mean and standard deviation of 20 observations were calculated as 10 and 2.5 respectively. It was found that by mistake one data value was taken as 25 instead of 35. If α and $\sqrt{\beta}$ are the mean and standard deviation respectively for correct data, then (α, β) is:

(1) $(10.5, 26)$ (2) $(10.5, 25)$

(3) $(11, 25)$ (4) $(11, 26)$

Q71. Out of all the patients in a hospital 89% are found to be suffering from heart ailment and 98% are suffering from lungs infection. If K% of them are suffering from both ailments, then K can not belong to the set:

(1) $\{79, 81, 83, 85\}$ (2) $\{84, 87, 90, 93\}$

(3) $\{80, 83, 86, 89\}$ (4) $\{84, 86, 88, 90\}$

Q72. If $A=\begin{bmatrix}\frac{1}{\sqrt{5}} & \frac{2}{\sqrt{5}} \\ \frac{-2}{\sqrt{5}} & \frac{1}{\sqrt{5}}\end{bmatrix}, B=\begin{bmatrix}1 & 0 \\ i & 1\end{bmatrix}, i=\sqrt{-1}$, and $Q=A^TBA$, then the inverse of the matrix $AQ^{2021}A^{\mathrm{T}}$ is equal to:

(1) $\begin{bmatrix}1 & -2021 \\ 0 & 1\end{bmatrix}$ (2) $\begin{bmatrix}1 & 0 \\ -2021i & 1\end{bmatrix}$

(3) $\begin{bmatrix}\frac{1}{\sqrt{5}} & -2021 \\ 2021 & \frac{1}{\sqrt{5}}\end{bmatrix}$ (4) $\begin{bmatrix}1 & 0 \\ 2021 & i & 1\end{bmatrix}$

Q73. Let $\theta \in \left(0, \frac{\pi}{2}\right)$. If the system of linear equations

$\left(1+\cos^2\theta\right)x+\sin^2\theta y+4\sin 3\theta z=0$

$\cos^2\theta x+\left(1+\sin^2\theta\right)y+4\sin 3\theta z=0$

$\cos^2\theta x+\sin^2\theta y+\left(1+4\sin 3\theta\right)z=0$

has a non-trivial solution, then the value of θ is:

(1) $\frac{4\pi}{9}$ (2) $\frac{5\pi}{18}$

(3) $\frac{7\pi}{18}$ (4) $\frac{\pi}{18}$

Q74. Let $f\left(x\right)=\cos\left(2\tan^{-1}\sin\left(\cot^{-1}\sqrt{\frac{1-x}{x}}\right)\right), 0<x<1$. Then:

(1) $(1-x)^2f'(x)+2(f(x))^2=0$ (2) $(1+x)^2f'(x)+2(f(x))^2=0$

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

Q75. The value of $\lim\limits_{n\to\infty}\frac{1}{n}\sum_{r=0}^{2n-1}\frac{n^2}{n^2+4r^2}$ is:

(1) $\frac{1}{2}\tan^{-1}(2)$ (2) $\tan^{-1}(4)$

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

Q76. The value of $\int_{\frac{-1}{\sqrt{2}}}^{\frac{1}{\sqrt{2}}} \left(\left(\frac{x+1}{x-1}\right)^2+\left(\frac{x-1}{x+1}\right)^2-2\right)^{\frac{1}{2}} dx$ is:

(1) $\log_e 4$ (2) $2\log_e 16$

(3) $\log_e 16$ (4) $4\log_e\left(3+2\sqrt{2}\right)$

Q77. Let $y=y(x)$ be a solution curve of the differential equation $(y+1)\tan^2 x dx+\tan x dy+y dx=0$, $x\in\left(0,\frac{\pi}{2}\right)$. If $\lim\limits_{x\to 0^+} xy(x)=1$, then the value of $y\left(\frac{\pi}{4}\right)$ is:

(1) $\frac{\pi}{4}+1$ (2) $\frac{\pi}{4}-1$

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

Q78. Let $\vec{a}=\hat{i}+\hat{j}+\hat{k}$ and $\vec{b}=\hat{j}-\hat{k}$. If $\vec{c}$ is a vector such that $\vec{a}\times\vec{c}=\vec{b}$ and $\vec{a}\cdot\vec{c}=3$, then $\vec{a}\cdot\left(\vec{b}\times\vec{c}\right)$ is equal to:

(1) 6 (2) -2

(3) 2 (4) -6

Q79. A plane P contains the line $x+2y+3z+1=0=x-y-z-6$, and is perpendicular to the plane $-2x+y+z+8=0$. Then which of the following points lies on P?

(1) $(2,-1,1)$ (2) $(0,1,1)$

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

Q80. Let A and B be independent events such that $\mathrm{P(A)}=\mathrm{p}, \mathrm{P(B)}=2\mathrm{p}$. The largest value of p, for which P (exactly one of A, B occurs)$=\frac{5}{9}$, is:

(1) $\frac{4}{9}$ (2) $\frac{1}{5}$

(3) $\frac{5}{12}$ (4) $\frac{2}{9}$

Q81. The sum of all integral values of $k(k\neq 0)$ for which the equation $\frac{2}{x-1}-\frac{1}{x-2}=\frac{2}{k}$ in x has no real roots, is_____.

Q82. Let $z=\frac{1-i\sqrt{3}}{2}, i=\sqrt{-1}$. Then the value of $21+\left(z+\frac{1}{z}\right)^3+\left(z^2+\frac{1}{z^2}\right)^3+\left(z^3+\frac{1}{z^3}\right)^3+\ldots+\left(z^{21}+\frac{1}{z^{21}}\right)^3$ is_____.

Q83. The number of three-digit even numbers, formed by the digits $0,1,3,4,6,7$ if the repetition of digits is not allowed, is_____.

Q84. If ${}^1P_1+2\cdot{}^2P_2+3\cdot{}^3P_3+\ldots+15\cdot{}^{15}P_{15}={}^qP_r-s,\ 0\le s\le 1$, then ${}^{q+s}C_{r-s}$ is equal to

Q85. The locus of a point, which moves such that the sum of squares of its distances from the points $(0,0),(1,0),(0,1)(1,1)$ is 18 units, is a circle of diameter d. Then d^2 is equal to

Q86. Let $a,b\in R, b\neq 0$. Defined a function, $f(x)=\begin{cases} a\sin\frac{\pi}{2}(x-1), & \text{for } x\le 0 \\ \frac{\tan 2x-\sin 2x}{bx^3}, & \text{for } x>0 \end{cases}$

If f is continuous at $x=0$, then $10-ab$ is equal to

Q87. If $y=y(x)$ is an implicit function of x such that $\log_e(x+y)=4xy$, then $\frac{d^2y}{dx^2}$ at $x=0$ is equal to

Q88. A wire of length 36 m is cut into two pieces, one of the pieces is bent to form a square and the other is bent to form a circle. If the sum of the areas of the two figures is minimum, and the circumference of the circle is k (meter), then $\left(\frac{4}{\pi}+1\right)k$ is equal to

Q89. The area of the region $S=\left\{(x, y): 3x^2 \leq 4y \leq 6x+24\right\}$ is_____.

Q90. Let the line L be the projection of the line $\frac{x-1}{2}=\frac{y-3}{1}=\frac{z-4}{2}$ in the plane $x-2y-z=3$. If d is the distance of the point $(0,0,6)$ from L, then d^2 is equal to

ANSWER KEYS

1. (2)	**2.** (4)	**3.** (2)	**4.** (1)	**5.** (3)	**6.** (2)	**7.** (3)	**8.** (3)
9. (1)	**10.** (4)	**11.** (1)	**12.** (3)	**13.** (2)	**14.** (2)	**15.** (1)	**16.** (3)
17. (2)	**18.** (4)	**19.** (2)	**20.** (3)	**21.** (50)	**22.** (40)	**23.** (52)	**24.** (2)
25. (1)	**26.** (2025)	**27.** (1)	**28.** (354)	**29.** (300)	**30.** (2)	**31.** (1)	**32.** (4)
33. (1)	**34.** (3)	**35.** (3)	**36.** (4)	**37.** (4)	**38.** (2)	**39.** (3)	**40.** (4)
41. (4)	**42.** (3)	**43.** (3)	**44.** (3)	**45.** (2)	**46.** (4)	**47.** (1)	**48.** (2)
49. (4)	**50.** (2)	**51.** (3)	**52.** (2)	**53.** (718)	**54.** (3)	**55.** (5)	**56.** (4)
57. (3)	**58.** (1)	**59.** (7)	**60.** (4)	**61.** (4)	**62.** (1)	**63.** (3)	**64.** (1)
65. (4)	**66.** (2)	**67.** (3)	**68.** (2)	**69.** (2)	**70.** (1)	**71.** (1)	**72.** (2)
73. (3)	**74.** (1)	**75.** (3)	**76.** (3)	**77.** (3)	**78.** (2)	**79.** (2)	**80.** (3)
81. (66)	**82.** (13)	**83.** (52)	**84.** (136)	**85.** (16)	**86.** (14)	**87.** (40)	**88.** (36)
89. (27)	**90.** (26)						