Q1. When vector $\vec{A} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ is subtracted from vector $\vec{B}$, it gives a vector equal to $2\hat{j}$. Then the magnitude of vector $\vec{B}$ will be:

(1) $\sqrt{5}$

(2) 3

(3) $\sqrt{6}$

(4) $\sqrt{33}$

Q2. If force (F), velocity (V) and time (T) are considered as fundamental physical quantity, then dimensional formula of density will be :

(1) $F V^4 T^{-6}$

(2) $F V^{-4} T^{-2}$

(3) $F^2 V^{-2} T^6$

(4) $F V^{-2} T^2$

Q3. A projectile is projected at $30°$ from horizontal with initial velocity 40 m s^{-1}. The velocity of the projectile at $t = 2$ s from the start will be:

(1) $40\sqrt{3} \text{ m s}^{-1}$

(2) Zero

(3) 20 m s^{-1}

(4) $20\sqrt{3} \text{ m s}^{-1}$

Q4. A body of mass 500 g moves along x-axis such that it's velocity varies with displacement x according to the relation $v = 10\sqrt{x} \text{ m s}^{-1}$ the force acting on the body is:

(1) 125 N

(2) 25 N

(3) 166 N

(4) 5 N

Q5. A block of mass 5 kg starting from rest pulled up on a smooth incline plane making an angle of $30°$ with horizontal with an effective acceleration of 1 m s^{-2}. The power delivered by the puling force at $t = 10$ s from the start is _____ W.

[Use $g = 10 \text{ m s}^{-2}$]

(Calculate the nearest integer value)

Q6. A nucleus disintegrates into two nuclear parts, in such a way that ratio of their nuclear sizes is $1 : 2^{1/3}$. Their respective speed have a ratio of $n : 1$. The value of n is_____

Q7. A circular plate is rotating in horizontal plane, about an axis passing through its centre and perpendicular to the plate, with an angular velocity ω. A person sits at the centre having two dumbbells in his hands. When he stretched out his hands, the moment of inertia of the system becomes triple. If E be the initial Kinetic energy of the system, then final Kinetic energy will be $\frac{E}{x}$. The value of x is

Q8. A space ship of mass 2×10^4 kg is launched into a circular orbit close to the earth surface. The additional velocity to be imparted to the space ship in the orbit to overcome the gravitational pull will be (if $g = 10 \text{ m s}^{-2}$ and radius of earth $= 6400$ km):

(1) $11.2\left(\sqrt{2} - 1\right) \text{ km s}^{-1}$

(2) $8\left(\sqrt{2} - 1\right) \text{ km s}^{-1}$

(3) $7.9\left(\sqrt{2} - 1\right) \text{ km s}^{-1}$

(4) $7.4\left(\sqrt{2} - 1\right) \text{ km s}^{-1}$

Q9. Eight equal drops of water are falling through air with a steady speed of 10 cm s^{-1}. If the drops coalesce, the new velocity is:-

(1) 16 cm s^{-1}

(2) 40 cm s^{-1}

(3) 5 cm s^{-1}

(4) 10 cm s^{-1}

Q10. The surface tension of soap solution is $3.5 \times 10^{-2} \, \text{N m}^{-1}$. The amount of work done required to increase the radius of soap bubble from 10 cm to 20 cm is _____ $\times 10^{-4} \, \text{J}$. (take $\pi = \frac{22}{7}$)

Q11. The thermodynamic process, in which internal energy of the system remains constant is

(1) Isochoric   (2) Adiabatic

(3) Isothermal   (4) Isobaric

Q12. The root mean square speed of molecules of nitrogen gas at $27°\text{C}$ is approximately: (Given mass of a nitrogen molecule $= 4.6 \times 10^{-26}$ kg and take Boltzmann constant $k_B = 1.4 \times 10^{-23} \text{J K}^{-1}$)

(1) 27.4 m s^{-1} (2) 91 m s^{-1}

(3) 1260 m s^{-1} (4) 523 m s^{-1}

Q13. A car P travelling at 20 m s^{-1} sounds its horn at a frequency of 400 Hz. Another car Q is travelling behind the first car in the same direction with a velocity 40 m s^{-1}. The frequency heard by the passenger of the car Q is approximately [Take, velocity of sound $= 360 \text{ m s}^{-1}$]

(1) 421 Hz   (2) 471 Hz

(3) 485 Hz   (4) 514 Hz

Q14. A wire of density $8 \times 10^3 \text{ kg m}^{-3}$ is stretched between two clamps 0.5 m apart. The extension developed in the wire is 3.2×10^{-4} m. If $Y = 8 \times 10^{10} \text{ N m}^{-2}$, the fundamental frequency of vibration in the wire will be _____ Hz

Q15. If V is the gravitational potential due to sphere of uniform density on its surface, then its value at the centre of sphere will be:

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

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

Q16. A capacitor of capacitance C is charged to a potential V. The flux of the electric field through a closed surface enclosing the positive plate of the capacitor is:

(1) $\frac{CV}{\varepsilon_0}$ (2) Zero

(3) $\frac{2CV}{\varepsilon_0}$ (4) $\frac{CV}{2\varepsilon_0}$

Q17. In the given circuit. $C_1 = 2\mu\text{F}, C_2 = 0.2\mu\text{F}, C_3 = 2\mu\text{F}, C_4 = 4\mu\text{F}, C_5 = 2\mu\text{F}, C_6 = 2\mu\text{F}$. The charge stored on capacitor C_4 is _____ μC.
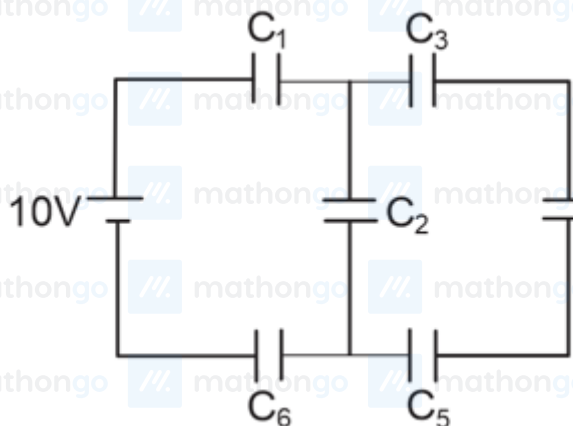
Q18.
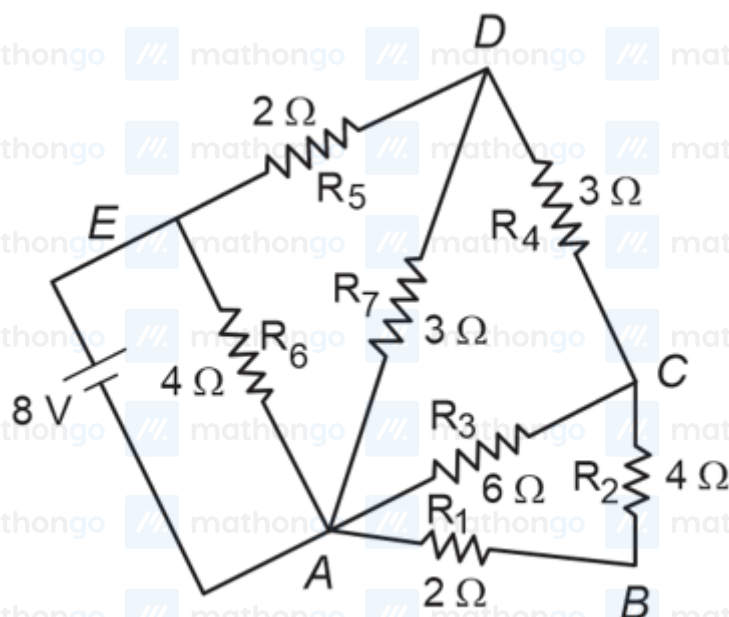
The current flowing through R_2 is :

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

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

(3) $\frac{1}{3}$ A

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

Q19. Two identical cells each of emf 1.5 V are connected in series across a $10\ \Omega$ resistance. An ideal voltmeter connected across $10\ \Omega$ resistance reads 1.5 V. The internal resistance of each cell is _____ Ω.

Q20. Given below are two statements: one is labelled as

Assertion A and the other is labelled as **Reason R**

Assertion A: A bar magnet dropped through a metallic cylindrical pipe takes more time to come down compared to a non-magnetic bar with same geometry and mass.

Reason R: For the magnetic bar, Eddy currents are produced in the metallic pipe which oppose the motion of the magnetic bar.

In the light of the above statements, choose the correct answer from the options given below

(1) $\mathbf{A}$ is false but $\mathbf{R}$ is true

(2) Both $\mathbf{A}$ and R are true and $\mathbf{R}$ is the correct explanation of $\mathbf{A}$

(3) $\mathbf{A}$ is true but $\mathbf{R}$ is false

(4) Both $\mathbf{A}$ and $\mathbf{R}$ are true and $\mathbf{R}$ is NOT the correct explanation of $\mathbf{A}$

Q21. An electron is allowed to move with constant velocity along the axis of current carrying straight solenoid.

(A) The electron will experience magnetic force along the axis of the solenoid.

(B) The electron will not experience magnetic force.

(C) The electron will continue to move along the axis of the solenoid.

(D) The electron will be accelerated along the axis of the solenoid.

(E) The electron will follow parabolic path-inside the solenoid.

Choose the correct answer from the option given below:

(1) B, C and D only

(2) A and D only

(3) B and C only

(4) B and E only

Q22. A metallic cube of side 15 cm moving along y-axis at a uniform velocity of $2 \mathrm{~m~s^{-1}}$. In a region of uniform magnetic field of magnitude 0.5 T directed along z- axis. In equilibrium the potential difference between the faces of higher and lower potential developed because of the motion through the field will be mV.
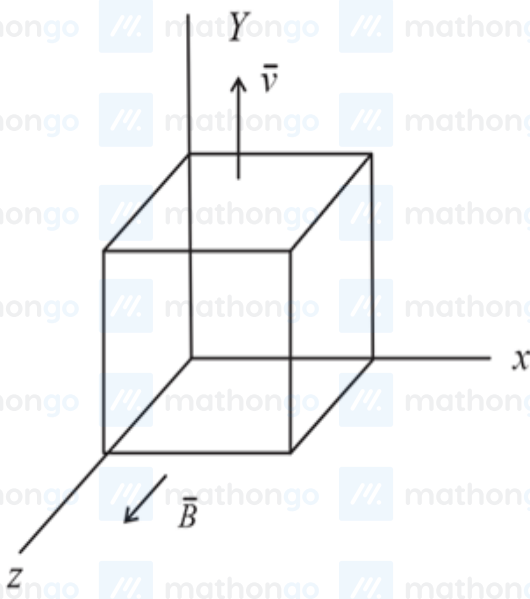
Q23. A coil has an inductance of 2 H and resistance of 4 Ω. A 10 V is applied across the coil. The energy stored in the magnetic field after the current has built up to its equilibrium value will be _____ $\times 10^{-2}$ J

Q24. A plane electromagnetic wave of frequency 20 MHz propagates in free space along x-direction. At a particular space and time $\overrightarrow{E} = 6.6\widehat{j}$ V m^{-1}. What is $\overrightarrow{B}$ at this point?

(1) $2.2 \times 10^{-8}\widehat{k}$T

(2) $-2.2 \times 10^{-8}\widehat{i}$T

(3) $-2.2 \times 10^{-8}\widehat{k}$T

(4) $2.2 \times 10^{-8}\widehat{i}$ T

Q25. When one light ray is reflected from a plane mirror with 30° angle of reflection, the angle of deviation of the ray after reflection is:

(1) $120°$ (2) $110°$

(3) $140°$ (4) $130°$

Q26. As shown in the figure, a plane mirror is fixed at a height of 50 cm from the bottom of tank containing water $\left(\mu = \frac{4}{3}\right)$. The height of water in the tank is 8 cm. A small bulb is placed at the bottom of the water tank. The distance of image of the bulb formed by mirror from the bottom of the tank is _____ cm.
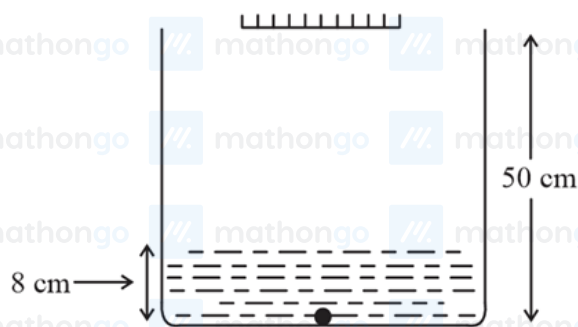
Q27. The ratio of the de-Broglie wavelengths of proton and electron having same kinetic energy:

(Assume $m_p = m_e \times 1849$)

(1) $1 : 43$ (2) $1 : 30$

(3) $1 : 62$ (4) $2 : 43$

Q28. The energy of He^+ ion in its first state is, (The ground state energy for the Hydrogen atom-13.6 eV):

(1) -27.2 eV   (2) -3.4 eV

(3) -13.6 eV   (4) -54.4 eV

Q29. The logic operations performed by the given digital circuit is equivalent to:
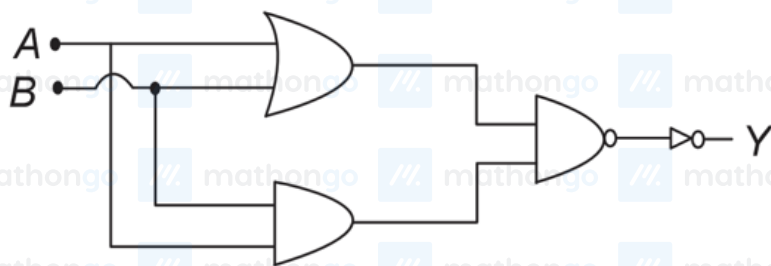
(1) NOR   (2) AND

(3) OR   (4) NAND

Q30. In satellite communication, the uplink frequency band used is:

(1) $420 - 890$ MHz   (2) $5.925 - 6.425$ GHz

(3) $76 - 88$ MHz   (4) $3.7 - 4.2$ GHz

Q31. A solution is prepared by adding 2 g of ''X'' to 1 mole of water. Mass percent of ''X''in solution is

(1) 5% (2) 20%

(3) 2% (4) 10%

Q32. The volume of hydrogen liberated at STP by treating 2.4 g of magnesium with excess of hydrochloric acid is ......$\times 10^{-2}$ L. Given Molar volume of gas is 22.4 L at STP. Molar mass of magnesium is 24 g mol^{-1}

Q33. The number of correct statements from the following is ....

A. For 1s orbital, the probability density is maximum at the nucleus

B. For 2s orbital, the probability density first increases to maximum and then decreases sharply to zero.

C. Boundary surface diagrams of the orbitals encloses a region of 100% probability of finding the electron.

D. p and d-orbitals have 1 and 2 angular nodes respectively

E. probability density of p-orbital is zero at the nucleus

Q34. Which one of the following pairs is an example of polar molecular solids?

(1) $SO_2(s), CO_2(s)$

(2) $SO_2(s), NH_3(s)$

(3) $MgO(s), SO_2(s)$

(4) $HCl(s), AlN(s)$

Q35. The maximum number of lone pairs of electron on the central atom from the following species is ...... ClO_{3-}, XeF_4, SF_4 and l_{3-}

Q36. The total number of intensive properties from the following is...........

Volume, Molar heat capacity, molarity, E^o_{cell}, Gibbs free energy change, Molar mass, Mole

Q37. 4.5 moles each of hydrogen and iodine is heated in a sealed ten litre vessel. At equilibrium, 3 moles of HI were found. The equilibrium constant for $H_2(g) + I_2(g) \rightleftharpoons 2HI_{(g)}$ is ....

**Q38.** Which hydride among the following is less stable?

(1) BeH_2

(2) HF

(3) NH_3

(4) LiH

Q39. Alkali metal from the following with least melting point is

(1) Cs

(2) Rb

(3) Na

(4) K

**Q40.** $Mg(NO_3)_2 \cdot XH_2O$ and $Ba(NO_3)_2 \cdot YH_2O$, represent formula of the crystalline forms of nitrate salts. Sum of X and Y is.......

**Q41.** Compound from the following that will not produce precipitate on reaction with $AgNO_3$ is

(1)

—Br

(2)

Br

(3)

—CH = CH—\ Br

(4)

Br
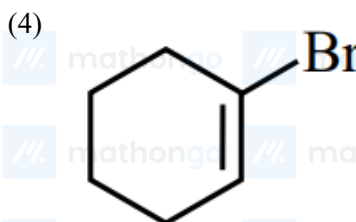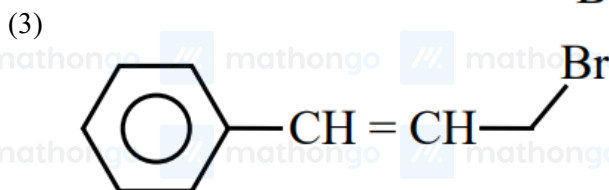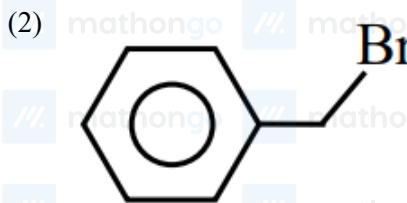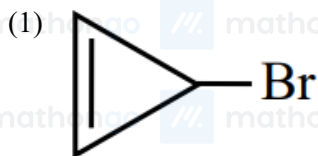
Q42. The number of possible isomeric products formed when 3-chloro-1-butene reacts with HCl through carbocation formation is.........

Q43. Given below are two statements, one is labelled as Assertion **A** and the other is labelled as Reason **R**.
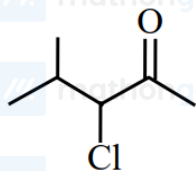
Assertion **A**: [structure] can be subjected to Wolff-Kishner reduction to give [structure]
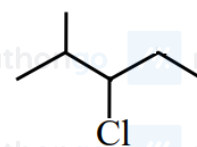
Reason **R**: Wolff-Kishner reduction is used to convert [structure] into [structure]

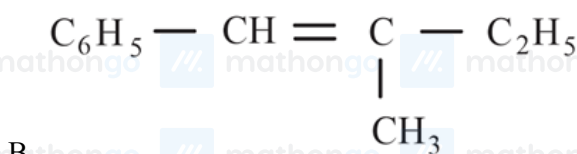In the light of the above statements, choose the correct answer from the options given below:
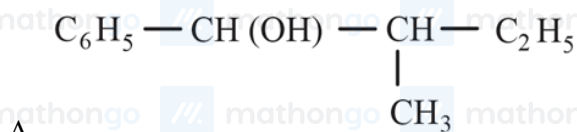
(1) **A** is true but **R** is false

(2) **A** is false but **R** is true

(3) Both **A** and **R** are true and **R** is the correct explanation of **A**

(4) Both **A** and **R** are true and **R** is NOT the correct explanation of **A**

Q44. The major product formed in the following reaction is

$$C_6H_5-CH\ (OH)-\underset{\underset{CH_3}{|}}{CH}-CH_2\ CHO \xrightarrow[\Delta]{Zn(Hg)/HCl} \text{Major product}$$

A. $C_6H_5-CH\ (OH)-\underset{\underset{CH_3}{|}}{CH}-C_2H_5$

B. $C_6H_5-CH=\underset{\underset{CH_3}{|}}{C}-C_2H_5$

C. $C_6H_5 - \underset{\underset{CH_3}{|}}{C} = CH - C_2H_5$

D.
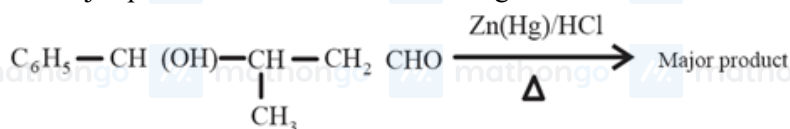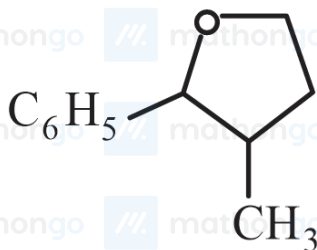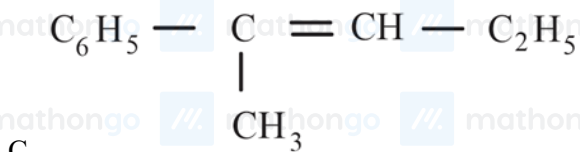
choose the correct answer from the options Given below:

(1) B only

(2) A only

(3) C only

(4) D only

Q45. Which of the following compounds is an example of Freon?

(1) $C_2H_2F_2$

(2) C_2F_4

(3) C_2HF_3

(4) $C_2Cl_2F_2$

Q46. What weight of glucose must be dissolved in 100 g of water to lower the vapour pressure by 0.20 mm Hg? (Assume dilute solution is being formed)

Given: Vapour pressure of pure water is 54.2 mm Hg at room temperature.Molar mass of glucose is 180 g mol^{-1}

(1) 3.59 g

(2) 3.69 g

(3) 4.69 g

(4) 2.59 g

Q47. The number of correct statements from the following is...........

A. E_{cell} is an intensive parameter

B. A negative E^o means that the redox couple is a stronger reducing agent than the H^+/H_2 couple.

C. The amount of electricity required for oxidation or reduction depends on the stoichiometry of the electrode reaction.

D. The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte.

Q48. For a chemical reaction $A + B \rightarrow$ Product, the order is 1 with respect to A and B.

Rate	[A]	[B]
mol $L^{-1}S^{-1}$	mol L^{-1}	mol L^{-1}
0.10	20	0.5
0.40	x	0.5
0.80	40	y

What is the value of x and y?

(1) 160 and 4

(2) 80 and 4

(3) 80 and 2

(4) 40 and 4

Q49. The number of correct statements about modern adsorption theory of heterogeneous catalysis from the following is ......

A. The catalyst is diffused over the surface of reactants.

B. Reactants are adsorbed on the surface of the catalyst.

C. Occurrence of chemical reaction on the catalyst's surface through formation of an intermediate.

D. It is a combination of intermediate compound formation theory and the old adsorption theory.

E. It explains the action of the catalyst as well as those of catalytic promoters and poisons.

Q50. Given below are two statements:

Statement I: In the metallurgy process, sulphide ore is converted to oxide before reduction.

Statement II: Oxide ores in general are easier to reduce.

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

(1) **Statement I** is correct but **Statement II** is incorrect

(2) Both **Statement I** and **Statement II** are incorrect

(3) **Statement I** is incorrect but **Statement II** is correct

(4) Both **Statement I** and **Statement II** are correct

Q51. Given below are two statements, one is labelled as **Assertion A** and the other is labelled as **Reasom R**.

Assertion A: A solution of the product obtained by heating a mole of glycine with a mole of chlorine in presence of red phosphorous generates chiral carbon atom.

Reason R: A molecule with 2 chiral carbons is always optically active.

In the light of above statements, chose the correct answer from the options given below:

(1) **A** is true but **R** is false

(2) Both **A** and **R** are true but **R** is the correct explaination of **A**

(3) **A** is false but **R** is true

(4) Both **A** and **R** are true but **R** is NOT the correct explaination of **A**

Q52. One mole of P_4 reacts with 8 moles of $SOCl_2$ to give 4 moles of A, x mole of SO_2 and 2 moles of B. A, B and x respectively are

(1) $POCl_3$, S_2Cl_2 and 2

(2) PCl_3, S_2Cl_2 and 4

(3) PCl_3, S_2Cl_2 and 2

(4) $POCl_3$, S_2Cl_2 and 4

Q53. If Ni^{2+} is replaced by Pt^{2+} in the complex $[NiCl_2Br_2]^{2-}$, which of the following properties are expected to get changed?
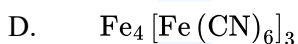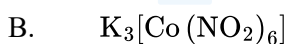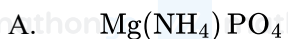
A. Geometry

B. Geometrical isomerism

C. Optical isomerism

D. Magnetic properties

(1) A and D

(2) A, B and C

(3) B and C

(4) A, B and D

Q54. Match List I with List II

LIST-I	**LIST-II**
Complex	**Colour**

A.	$Mg(NH_4)PO_4$	I.	brown
B.	$K_3[Co(NO_2)_6]$	II.	white
C.	$MnO(OH)_2$	III.	yellow
D.	$Fe_4[Fe(CN)_6]_3$	IV.	blue

Choose the correct answer from the options given below:

(1) A-III, B-IV, C-II, D-I (2) A-II, B-III, C-I, D-IV

(3) A-II, B-IV, C-I, D-III (4) A-II, B-III, C-IV, D-I

Q55. Given below are two statements, one is labelled as assertion **A** and the other is labelled as Reason **R**.

assertion **A** : $[CoCl(NH_3)_5]^{2+}$ absorbs at lower wavelength of light with respect to $[Co(NH_3)_5(H_2O)]^{3+}$

Reason **R**: It is because the wavelenght of light absorbed depends on the oxidation state of the metal ion.

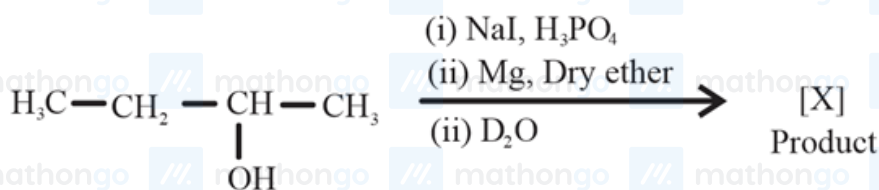In the light of the above statements,choose the correct answer from the options given below:

(1) **A** is false but **R** is true (2) **A** is true but **R** is false

(3) Both **A** and **R** are true and **R** is the correct explaination of **A** (4) Both **A** and **R** are true and **R** is NOT the correct explaination of **A**

Q56. The magnetic moment is measured in Bohr Magneton (BM). Spin only magnetic moment of Fe in $[Fe(H_2O)_6]^{3+}$ and $[Fe(CN)_6]^{3-}$ complexes respectively is:

(1) 6.92 B. M. in both (2) 3.87 B. M. and1.732 B. M.

(3) 5.92 B. M. and 1.732 B. M. (4) 4.89 B. M. and 6.92 B. M.

Q57.

$$H_3C-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3 \xrightarrow[\text{(ii) D}_2\text{O}]{\substack{\text{(i) NaI, H}_3\text{PO}_4 \\ \text{(ii) Mg, Dry ether}}} \underset{\text{Product}}{[X]}$$

Product [X] formed in the above reaction is:

(1)
$$H_3C-CH_2-\underset{\underset{OH}{|}}{\overset{\overset{H}{|}}{C}}-CH_3$$

(2) $H_3C-CH=CH-CH_3$

(3) $H_3C-CH_2-\underset{\underset{D}{|}}{CH}-CH_3$

(4) $H_3C-CH_2-CH=CH_2$
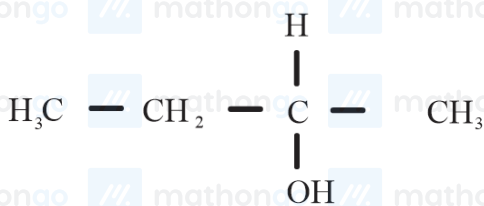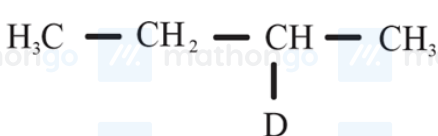
Q58. Number of compounds from the following which will not produce orange red precipitate with Benedict solution is........

Glucose, maltose, sucrose, ribose,2-deoxyribose, amylose, lactose

Q59. Compoun *B*/ is

NaNO$_2$ /HCl → A → NH$_4$SH → B(Major)

(1)

(2)

(3)

(4)
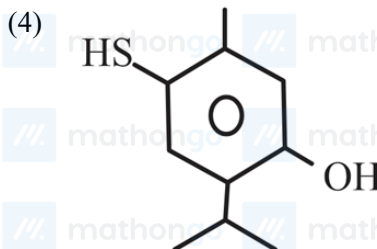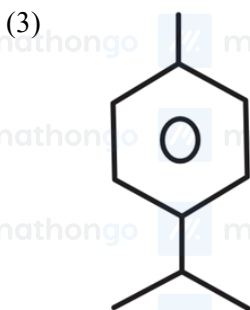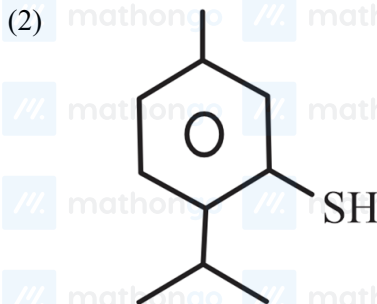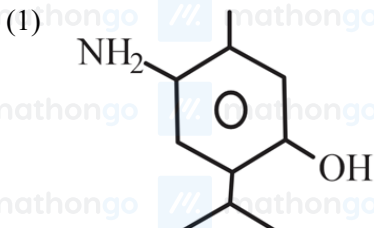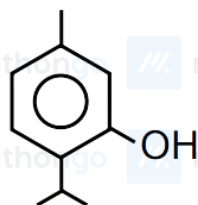
Q60. Given below are two statements:

Statement I: Ethane at 333 to 343 K and $6 - 7$ atm pressure in the presence of $AlEt_3$ and $TiCl_4$ undergoes addition polymerization to give LDP.

Statement II: Caprolactam at $533 - 543$ K in H_2O through step growth polymerizes to give Nylon 6.

In the light of the above statements, choose the correct 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 true   (4) Both **Statement I** and **Statement II** are false

Q61. The number of points, where the curve $f(x) = e^{8x} - e^{6x} - 3e^{4x} - e^{2x} + 1, x \in \mathbb{R}$ cuts x-axis, is equal to............

Q62. For $a \in \mathbb{C}$, let $A = \{z \in \mathbb{C} : \text{Re}\,(a + \bar{z}) > \text{Im}\,(\bar{a} + z)\}$ and $B = \{z \in \mathbb{C} : \text{Re}\,(a + \bar{z}) < \text{Im}\,(\bar{a} + z)\}$. Then among the two statements:

$(S1)$: If $\text{Re}\,(a), \text{Im}\,(a) > 0$, then the set A contains all the real numbers

$(S2)$: If $\text{Re}\,(a), \text{Im}\,(a) < 0$, then the set B contains all the real numbers,

(1) Only $(S2)$ is true   (2) only $(S1)$ is true

(3) Both are true   (4) Both are false

Q63. Let $S = \left\{z \in \mathbb{C} - \{i, 2i\} : \frac{z^2 + 8iz - 15}{z^2 - 3iz - 2} \in \mathbb{R}\right\}$. $\alpha - \frac{13}{11}i \in S, \alpha \in \mathbb{R} - \{0\}$, then $242\alpha^2$ is equal to

Q64. If the letters of the word MATHS are permuted and all possible words so formed are arranged as in a dictionary with serial numbers, then the serial number of the word THAMS is

(1) 103

(2) 102

(3) 101

(4) 104

Q65. Let a, b, c and d be positive real numbers such that $a + b + c + d = 11$. If the maximum value of $a^5 b^3 c^2 d$ is 3750β, then the value of β is

(1) 90

(2) 110

(3) 55

(4) 108

Q66. For $k \in \mathbb{N}$, if the sum of the series $1 + \frac{4}{k} + \frac{8}{k^2} + \frac{13}{k^3} + \frac{19}{k^4} + \ldots\ldots$ is 10, then the value of k is

Q67. If the 1011th term from the end in the binomial expansion of $\left(\frac{4x}{5} - \frac{5}{2x}\right)^{2022}$ is 1024 times 1011th term from the beginning, then $32|x|$ is equal to

(1) 15

(2) 10

(3) 12

(4) 8

Q68. The sum of the coefficients of three consecutive terms in the binomial expansion of $(1 + x)^{n+2}$, which are in the ratio $1 : 3 : 5$, is equal to

(1) 92

(2) 63

(3) 41

(4) 25

Q69. If the line $l_1 : 3y - 2x = 3$ is the angular bisector of the lines $l_2 : x - y + 1 = 0$ and $l_3 : \alpha x + \beta y + 17 = 0$, then $\alpha^2 + \beta^2 - \alpha - \beta$ is equal to ....

Q70. If the radius of the largest circle with centre $(2, 0)$ inscribed in the ellipse $x^2 + 4y^2 = 36$ is r, then $12\,r^2$ is equal to

(1) 115

(2) 92

(3) 69

(4) 72

Q71. Let the tangent to the parabola $y^2 = 12x$ at the point $(3, \alpha)$ be perpendicular to the line $2x + 2y = 3$. Then the square of distance of the point $(6, -4)$ from the normal to the hyperbola $\alpha^2 x^2 - 9y^2 = 9\alpha^2$ at its point $(\alpha - 1, \alpha + 2)$ is equal to ....

Q72. The converse of $((\sim p) \wedge q) \Rightarrow r$ is

(1) $((\sim p) \vee q) \Rightarrow r$

(2) $(\sim r) \Rightarrow p \wedge q$

(3) $(\sim r) \Rightarrow ((\sim p) \wedge q)$

(4) $(p \vee (\sim q)) \Rightarrow (\sim r)$

Q73. Let the mean of 6 observations $1, 2, 4, 5, x$ and y be 5 and their variance be 10. Then their mean deviation about the mean is equal to

(1) $\frac{7}{3}$

(2) 3

(3) $\frac{8}{3}$

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

Q74. The angle of elevation of the top P of a tower from the feet of one person standing due south of the tower is $45°$ and from the feet of another person standing due west of the tower is $30°$. If the height of the tower is 5 meters, then the distance (in meters) between the two persons is equal to

(1) $\frac{5}{2}\sqrt{5}$ (2) 10

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

Q75. Let $A = \{1, 3, 4, 6, 9\}$ and $B = \{2, 4, 5, 8, 10\}$. Let R be a relation defined on $A \times B$ such that $R = \{(a_1, b_1), (a_2, b_2) : a_1 \leq b_2 \text{ and } b_1 \leq a_2\}$. Then the number of elements in the set R is

(1) 160   (2) 52

(3) 26   (4) 180

Q76. If the system of linear equations

$7x + 11y + \alpha z = 13$

$5x + 4y + 7z = \beta$

$175x + 194y + 57z = 361$

has infinitely many solutions, then $\alpha + \beta + 2$ is equal to

(1) 4   (2) 3

(3) 5   (4) 6

Q77. If $\begin{vmatrix} x+1 & x & x \\ x & x+\lambda & x \\ x & x & x+\lambda^2 \end{vmatrix} = \frac{9}{8}(103x + 81)$, then $\lambda, \frac{\lambda}{3}$ are the roots of the equation

(1) $4x^2 + 24x - 27 = 0$ (2) $4x^2 - 24x - 27 = 0$

(3) $4x^2 + 24x + 27 = 0$ (4) $4x^2 - 24x + 27 = 0$

Q78. The domain of the function $f(x) = \frac{1}{\sqrt{[x]^2 - 3[x] - 10}}$ is (where $[x]$ denotes the greatest integer less than or equal to x)

(1) $(-\infty, -3] \cup (5, \infty)$ (2) $(-\infty, -2) \cup [6, \infty)$

(3) $(-\infty, -2) \cup (5, \infty)$ (4) $(-\infty, -3] \cup [6, \infty)$

Q79. Let $A = \{1, 2, 3, 4, 5\}$ and $B = \{1, 2, 3, 4, 5, 6\}$. Then the number of functions $f : A \to B$ satisfying $f(1) + f(2) = f(4) - 1$ is equal to........

Q80. Let f and g be two functions defined by $f(x) = \begin{cases} x+1, & x < 0 \\ |x-1|, & x \geq 0 \end{cases}$ and $g(x) = \begin{cases} x+1, & x < 0 \\ 1, & x \geq 0 \end{cases}$. Then $(g \circ f)(x)$ is

(1) Continuous everywhere but not differentiable exactly at one point   (2) Continuous everywhere but not differentiable at $x = 1$

(3) Differentiable everywhere   (4) Not continuous at $x = 1$

Q81. Let the function $f : [0, 2] \to \mathbb{R}$ be defined as $f(x) = \begin{cases} e^{\min\{x^2, x-[x]\}}, & x \in [0, 1) \\ e^{[x - \log_e x]}, & x \in [1, 2] \end{cases}$, where $[t]$ denotes the greatest integer less than or equal to t. Then the value of the integral $\int_0^2 x f(x) dx$ is

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

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

Q82. If $f : \mathbb{R} \to \mathbb{R}$ be a continuous function satisfying $\int_0^{\frac{\pi}{2}} f(\sin 2x) \sin x \, dx + \alpha \int_0^{\frac{\pi}{4}} f(\cos 2x) \cos x \, dx = 0$, then the value of α is

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

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

Q83. If A is the area in the first quadrant enclosed by the curve $C : 2x^2 - y + 1 = 0$, the tangent to C at the point $(1, \ 3)$ and the line $x + y = 1$, then the value of $60A$ is...............

Q84. Let $y = y(x)$ be the solution of the differential equation $\frac{dy}{dx} + \frac{5}{x(x^5+1)}y = \frac{(x^5+1)^2}{x^7}$, $x > 0$. If $y(1) = 2$, then $y(2)$ is equal to

(1) $\frac{637}{128}$ (2) $\frac{679}{128}$

(3) $\frac{693}{128}$ (4) $\frac{697}{128}$

Q85. If four distinct points with position vectors $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ are coplanar, then $\left[\vec{a}\vec{b}\vec{c}\right]$ is equal to

(1) $\left[\vec{d}\ \vec{b}\ \vec{a}\right] + \left[\vec{a}\ \vec{c}\ \vec{d}\right] + \left[\vec{d}\vec{b}\ \vec{c}\right]$ (2) $\left[\vec{a}\ \vec{d}\ \vec{b}\right] + \left[\vec{d}\ \vec{c}\ \vec{a}\right] + \left[\vec{d}\ \vec{b}\ \vec{c}\right]$

(3) $\left[\vec{d}\ \vec{c}\ \vec{a}\right] + \left[\vec{b}\ \vec{d}\ \vec{a}\right] + \left[\vec{c}\ \vec{d}\ \vec{b}\right]$ (4) $\left[\vec{b}\ \vec{c}\ \vec{d}\right] + \left[\vec{d}\ \vec{a}\ \vec{c}\right] + \left[\vec{d}\ \vec{b}\ \vec{a}\right]$

Q86. Let $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{b} = \hat{i} + \hat{j} - \hat{k}$. If $\vec{c}$ is a vector such that $\vec{a} \cdot \vec{c} = 11, \vec{b} \cdot \left(\vec{a} \times \vec{c}\right) = 27$ and $\vec{b} \cdot \vec{c} = -\sqrt{3}\left|\vec{b}\right|$, then $\left|\vec{a} \times \vec{c}\right|^2$ is equal to

Q87. Let P be the plane passing through the points $(5, 3, 0), (13, 3, -2)$ and $(1, 6, 2)$. For $\alpha \in \mathbb{N}$, if the distance of the points $A(3, 4, \alpha)$ and $B(2, \alpha, a)$ from the plane P are 2 and 3 respectively, then the positive value of a is

(1) 6   (2) 3

(3) 5   (4) 4

Q88. Let the line passing through the points $P(2, -1, 2)$ and $Q(5, 3, 4)$ meet the plane $x - y + z = 4$ at the point R. Then the distance of the point R from the plane $x + 2y + 3z + 2 = 0$ measured parallel to the line $\frac{x-7}{2} = \frac{y+3}{2} = \frac{z-2}{1}$ is

(1) $\sqrt{61}$ (2) $\sqrt{189}$

(3) $\sqrt{31}$ (4) 3

Q89. Let the line $L : x = \frac{1-y}{-2} = \frac{z-3}{\lambda}, \lambda \in \mathbb{R}$ meet the plane $P : \ x + 2\,y + 3\,z = 4$ at the point (α, β, γ). If the angle between the line L and the plane P is $\cos^{-1}\left(\sqrt{\frac{5}{14}}\right)$, then $\alpha + 2\beta + 6\gamma$ is equal to

Q90. Let the probability of getting head for a biased coin be $\frac{1}{4}$. It is tossed repeatedly until a head appears. Let N be the number of tosses required. If the probability that the equation $64x^2 + 5Nx + 1 = 0$ has no real root is $\frac{p}{q}$, where p and q are co-prime, then $q - p$ is equal to.........

ANSWER KEYS

1. (4)	**2.** (2)	**3.** (4)	**4.** (2)	**5.** (2)	**6.** (2)	**7.** (3)	**8.** (4)
9. (2)	**10.** (4)	**11.** (1)	**12.** (3)	**13.** (2)	**14.** (3)	**15.** (1)	**16.** (1)
17. (1)	**18.** (3)	**19.** (2)	**20.** (2)	**21.** (300)	**22.** (2)	**23.** (3)	**24.** (264)
25. (80)	**26.** (4)	**27.** (5)	**28.** (150)	**29.** (625)	**30.** (98)	**31.** (4)	**32.** (2)
33. (1)	**34.** (1)	**35.** (4)	**36.** (2)	**37.** (2)	**38.** (4)	**39.** (2)	**40.** (3)
41. (4)	**42.** (1)	**43.** (2)	**44.** (4)	**45.** (2)	**46.** (1)	**47.** (3)	**48.** (3)
49. (1)	**50.** (1)	**51.** (224)	**52.** (3)	**53.** (3)	**54.** (4)	**55.** (1)	**56.** (6)
57. (4)	**58.** (4)	**59.** (3)	**60.** (2)	**61.** (4)	**62.** (1)	**63.** (1)	**64.** (2)
65. (2)	**66.** (2)	**67.** (4)	**68.** (3)	**69.** (2)	**70.** (1)	**71.** (1)	**72.** (4)
73. (2)	**74.** (1)	**75.** (4)	**76.** (4)	**77.** (3)	**78.** (3)	**79.** (4)	**80.** (4)
81. (2)	**82.** (1680)	**83.** (2)	**84.** (348)	**85.** (116)	**86.** (360)	**87.** (16)	**88.** (285)
89. (11)	**90.** (27)						