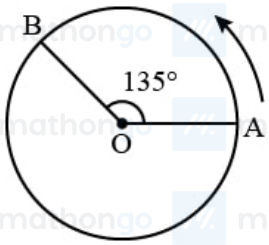
Q1. A person moved from A to B on a circular path as shown in figure. If the distance travelled by him is 60 m, then the magnitude of displacement would be : (Given $\cos 135° = -0.7$)



(1) 42 m
(2) 47 m
(3) 19 m
(4) 40 m

Q2. If momentum P, area A and time T are taken as fundamental quantities, then the dimensional formula for coefficient of viscosity is

(1) $PA^{-1}T^{0}$
(2) PAT^{-1}
(3) $PA^{-1}T$
(4) $PA^{-1}T^{-1}$

Q3. Which of the following physical quantities have the same dimensions?

(1) Electric displacement $\vec{D}$ and surface charge density
(2) Displacement current and electric field
(3) Current density and surface charge density
(4) Electric potential and energy

Q4. A body of mass 0.5 kg travels on straight line path with velocity $v = 3x^2 + 4$ m s^{-1}. The net work done by the force during its displacement from $x = 0$ to $x = 2$ m is

(1) 64 J
(2) 60 J
(3) 120 J
(4) 128 J

Q5. A solid cylinder and a solid sphere, having same mass M and radius R, roll down the same inclined plane from top without slipping. They start from rest. The ratio of velocity of the solid cylinder to that of the solid sphere, with which they reach the ground, will be

(1) $\sqrt{\frac{5}{3}}$
(2) $\sqrt{\frac{4}{5}}$
(3) $\sqrt{\frac{3}{5}}$
(4) $\sqrt{\frac{14}{15}}$

Q6. Three identical particle A, B and C of mass 100 kg each are placed in a straight line with $AB = BC = 13$ m. The gravitational force on a fourth particle P of the same mass is F, when placed at a distance 13 m from the particle B on the perpendicular bisector of the line AC. The value of F will be approximately

(1) $21G$
(2) $100G$
(3) $59G$
(4) $42G$

Q7. A certain amount of gas of volume V at 27°C temperature and pressure 2×10^{7} N m^{-2} expands isothermally until its volume gets doubled. Later it expands adiabatically until its volume gets redoubled. The final pressure of the gas will be (Use $\gamma = 1.5$)

(1) 3.536×10^{5} Pa
(2) 3.536×10^{6} Pa
(3) 1.25×10^{6} Pa
(4) 1.25×10^{5} Pa

Q8. Following statements are given

(1) The average kinetic energy of a gas molecule decreases when the temperature is reduced.

(2) The average kinetic energy of a gas molecule increases with increase in pressure at constant temperature.

(3) The average kinetic energy of a gas molecule decreases with increases in volume.

(4) Pressure of a gas increases with increase in temperature at constant volume.

(5) The volume of gas decreases with increase in temperature.

Choose the correct answer from the options given below :

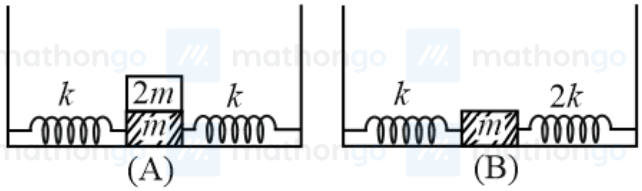
(1) (1) and (4) only

(2) (1), (2) and (4) only

(3) (2) and (4) only

(4) (1), (2) and (5) only

Q9. In figure (A), mass $2m$ is fixed on mass m which is attached to two springs of spring constant k. In figure (B), mass m is attached to two spring of spring constant k and $2k$. If mass m in (A) and (B) are displaced by distance x horizontally and then released, then time period T_1 and T_2 corresponding to (A) and (B) respectively follow the relation.



(1) $\frac{T_1}{T_2}=\frac{3}{\sqrt{2}}$

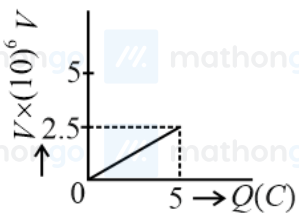
(2) $\frac{T_1}{T_2}=\sqrt{\frac{3}{2}}$

(3) $\frac{T_1}{T_2}=\sqrt{\frac{2}{3}}$

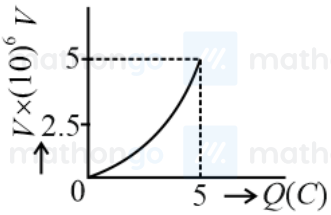
(4) $\frac{T_1}{T_2}=\frac{\sqrt{2}}{3}$

Q10. A condenser of 2 μF capacitance is charged steadily from 0 to 5 C. Which of the following graph represents correctly the variation of potential difference$V$ across its plates with respect to the charge Q on the condenser?

(1)



(2)



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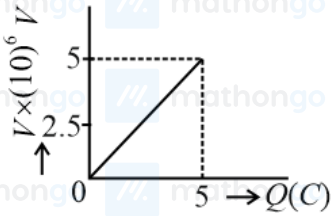
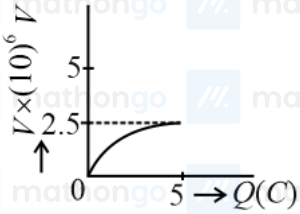


(4)



Q11. Two charged particles, having same kinetic energy, are allowed to pass through a uniform magnetic field perpendicular to the direction of motion. If the ratio of radii of their circular paths is 6: 5 and their respective masses ratio is 9: 4. Then, the ratio of their charges will be

(1) 8: 5

(2) 5: 4

(3) 5: 3

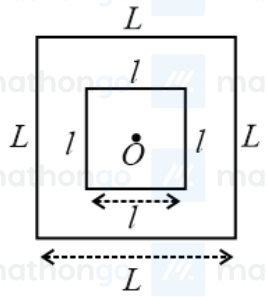
(4) 8: 7

Q12. The magnetic moment of an electron e revolving in an orbit around nucleus with an orbital angular momentum is given by

(1) $\vec{\mu}_L = \frac{eL}{2m}$ (2) $\vec{\mu}_L = -\frac{eL}{2m}$

(3) $\vec{\mu}_L = -\frac{e\vec{L}}{m}$ (4) $\vec{\mu}_L = \frac{2e\vec{L}}{m}$

Q13. A small square loop of wire of side l is placed inside a large square loop of wire $LL \gg l$. Both loops are coplanar and their centres coincide at point O as shown in figure. The mutual inductance of the system is



(1) $\frac{2\sqrt{2}\mu_0 L^2}{\pi l}$ (2) $\frac{\mu_0 l^2}{2\sqrt{2}\pi L}$

(3) $\frac{\mu_0 L^2}{2\sqrt{2}\pi l}$ (4) $\frac{2\sqrt{2}\mu_0 l^2}{\pi L}$

Q14. To increase the resonant frequency in series LCR circuit,

(1) Source frequency should be increased

(2) Another resistance should be added in series with the first resistance.

(3) Another capacitor should be added in series with the first capacitor

(4) The source frequency should be decreased

Q15. The RMS value of conduction current in a parallel plate capacitor is 6.9 μA. The capacity of this capacitor, if it is connected to 230 V AC supply with an angular frequency of 600 rad s^{-1}, will be

(1) 5pF (2) 50pF

(3) 100pF (4) 200pF

Q16. Which of the following statement is correct?

(1) In primary rainbow, observer sees red colour on the top and violet on the bottom

(2) In primary rainbow, observer sees violet colour on the top and red on the bottom

(3) In primary rainbow, light wave suffers total internal reflection twice before coming out of water drops

(4) Primary rainbow is less bright than secondary rainbow.

Q17. Time taken by light to travel in two different materials A and B of refractive indices μ_A and μ_B of same thickness is t_1 and t_2 respectively. If $t_2 - t_1 = 5 \times 10^{-10}$s and the ratio of μ_A to μ_B is 1: 2. Then the thickness of material, in meter is: (Given v_A and v_B are velocities of light in A and B materials respectively).

(1) $5 \times 10^{-10} v_A$ m (2) 5×10^{-10} m

(3) 1.5×10^{10} m (4) $5 \times 10^{-10} v_B$ m

Q18. A metal exposed to light of wavelength 800 nm and emits photoelectrons with a certain kinetic energy. The maximum kinetic energy of photo-electron doubles when light of wavelength 500 nm is used. The work

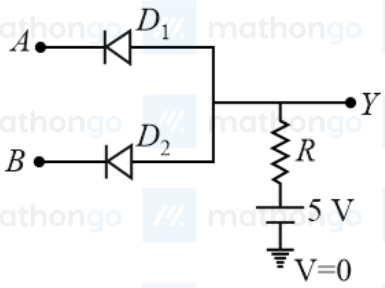
function of the metal is
(Take $hc = 1230$ eV - nm).

(1) 1.537eV (2) 2.46eV
(3) 0.615eV (4) 1.23eV

Q19. The momentum of an electron revolving in n^{th} orbit is given by : (Symbols have their usual meanings)

(1) $\frac{nh}{2\pi r}$ (2) $\frac{nh}{2r}$
(3) $\frac{nh}{2\pi}$ (4) $\frac{2\pi r}{nh}$

Q20. In the circuit, the logical value of $A = 1$ or $B = 1$ when potential at A or B is 5 V and the logical value of $A = 0$ or $B = 0$ when potential at A or B is 0V.



The truth table of the given circuit will be :

(1)

A	B	Y
0	0	0
1	0	0
0	1	0
1	1	1

(2)

A	B	Y
0	0	0
1	0	1
0	1	1
1	1	1

(3)

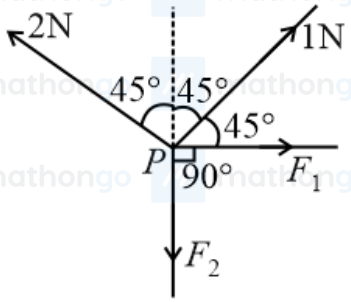
A	B	Y
0	0	0
1	0	0
0	1	0
1	1	0

(4)

A	B	Y
0	0	1
1	0	1
0	1	1
1	1	0

Q21. A car is moving with speed of 150 km h^{-1} and after applying the brake it will move 27 m before it stops. If the same car is moving with a speed of one third the reported speed then it will stop after travelling _____ m distance.

Q22. Four forces are acting at a point P in equilibrium as shown in figure. The ratio of force F_1 to F_2 is $1:x$ where $x =$ _____ .



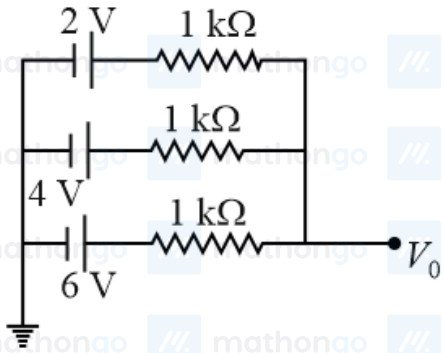
Q23. A wire of length L and radius r is clamped rigidly at one end. When the other end of the wire is pulled by a force F, its length increases by 5 cm. Another wire of the same material of length 4 L and radius $4r$ is pulled by a force 4 F under same conditions. The increase in length of this wire is _____ cm.

Q24. A unit scale is to be prepared whose length does not change with temperature and remains 20 cm, using a bimetallic strip made of brass and iron each of different length. The length of both components would change in such a way that difference between their lengths remains constant. If length of brass is 40 cm and length of iron will be _____ cm.
$\alpha_{\text{iron}} = 1.2 \times 10^{-5}$ K^{-1} and $\alpha_{\text{brass}} = 1.8 \times 10^{-5}$ K^{-1}.

Q25. An observer is riding on a bicycle and moving towards a hill at 18 km h^{-1}. He hears a sound from a source at some distance behind him directly as well as after its reflection from the hill. If the original frequency of the sound as emitted by source is 640 Hz and velocity of the sound in air is 320 m s^{-1}, the beat frequency between the two sounds heard by observer will be _____ Hz.

Q26. The volume charge density of a sphere of radius 6 m is 2 μC cm^{-3}. The number of lines of force per unit surface area coming out from the surface of the sphere is _____ $\times 10^{10}$ N C^{-1}.
[Given : Permittivity of vacuum $\epsilon_0 = 8.85 \times 10^{-12} C^2$ N^{-1} - m^{-2}]

Q27. In the given figure, the value of V_0 will be _____ V.



Q28. Eight copper wire of length l and diameter d are joined in parallel to form a single composite conductor of resistance R. If a single copper wire of length $2l$ have the same resistance R then its diameter will be _____ d.

Q29. The energy band gap of semiconducting material to produce violet (wavelength $= 4000$ Å) LED is _____ eV. (Round off to the nearest integer).

Q30. The required height of a TV tower which can cover the population of 6.03 lakh is h. If the average population density is 100 per square km and the radius of earth is 6400 km, then the value of h will be _____ m.

Q31. SO_2Cl_2 on reaction with excess of water results into acidic mixture $SO_2Cl_2 + 2H_2O \rightarrow H_2SO_4 + 2HCl$ 16 moles of NaOH is required for the complete neutralisation of the resultant acidic mixture. The number of moles of SO_2Cl_2 used is

(1) 16 (2) 8

(3) 4 (4) 2

Q32. Which of the following sets of quantum numbers is not allowed?

(1) $n = 3, \quad l = 2, \quad m_l = 0, \quad s = +\frac{1}{2}$ (2) $n = 3, \quad l = 2, \quad m_l = -2, \quad s = +\frac{1}{2}$

(3) $n = 3, \quad l = 3, \quad m_l = -3, \quad s = -\frac{1}{2}$ (4) $n = 3, \quad l = 0, \quad m_l = 0, \quad s = -\frac{1}{2}$

Q33. The IUPAC nomenclature of an element with electronic configuration $Rn5f^{14}6d^{1}7s^{2}$ is

(1) Unnilunium (2) Unnilbium

(3) Unniltrium (4) Unnilquadium

Q34. $20 \quad mL$ of $0.1M \quad NH_4OH$ is mixed with $40 \quad mL$ of $0.05 \quad M \quad HCl$. The pH of the mixture is nearest to:

(Given: $K_b NH_4OH = 1 \times 10^{-5}, \quad log2 = 0.30, log3 = 0.48, \quad log5 = 0.69, \quad log7 = 0.84, log11 = 1.04$)

(1) 3.2 (2) 4.2

(3) 5.2 (4) 6.2

Q35. The reaction of H_2O_2 with potassium permanganate in acidic medium leads to the formation of mainly

(1) Mn^{2+} (2) Mn^{4+}

(3) Mn^{3+} (4) Mn^{6+}

Q36. Choose the correct order of density of the alkali metals

(1) $Li < \quad K < Na < Rb < Cs$ (2) $Li < \quad Na < K \quad < Rb < Cs$

(3) $Li < Na < K < Cs < Rb$ (4) $Cs < Rb < K < Na < Li$

Q37. Match List - I with List - II

List-II		**List-II**	
A	$N_2g + 3H_2g \rightarrow 2NH_3g$	I	Cu
B	$COg + 3H_2g \rightarrow CH_4g + H_2Og$	II	$Cu / ZnO - Cr_2O_3$
C	$COg + H_2g \rightarrow HCHOg$	III	$Fe_xO_y + K_2O + Al_2O_3$
D	$COg + 2H_2g \rightarrow CH_3OHg$	IV	Ni

Choose the correct answer from the options given below

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

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

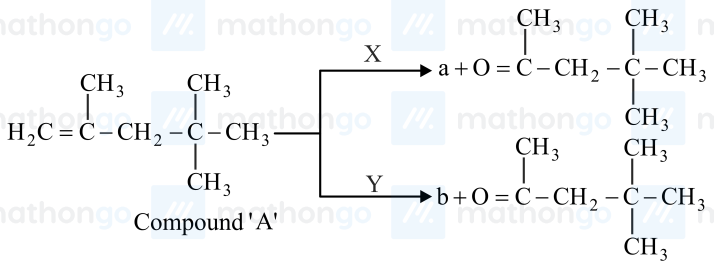
Q38. The geometry around boron in the product 'B' formed from the following reaction is

$$BF_3 + NaH \xrightarrow{450 \ K} A + NaF$$
$$A + NMe_3 \rightarrow B$$

(1) trigonal planar (2) tetrahedral

(3) pyramidal (4) square planar

Q39. A compound 'A' on reaction with 'X' and 'Y produces the same major product but different by product 'a' and 'b'. Oxidation of 'a' gives a substance produced by ants.



'X' and 'Y' respectively are

(1) $KMnO_4$ / H^+ and dil. $KMnO_4$, 273 K

(2) $KMnO_4$,(dilute), 273 K and $KMnO_4$ / H^+

(3) $KMnO_4$ / H^+ and O_3, H_2O / Zn

(4) O_3, H_2O / Zn and $KMnO_4$ / H^+

Q40. The photochemical smog does not generally contain

(1) NO

(2) NO_2

(3) SO_2

(4) HCHO

Q41. The depression in freezing point observed for a formic acid solution of concentration 0.5 mL L^{-1} is 0.0405 °C. Density of formic acid is 1.05 g mL^{-1}. The Van't Hoff factor of the formic acid solution is nearly: (Given for water $k_f = 1.86$ K kg mol^{-1})

(1) 0.8

(2) 1.1

(3) 1.9

(4) 2.4

Q42. The compound(s) that is(are) removed as slag during the extraction of copper is :

(1) CaO

(2) FeO

(3) Al_2O_3

(4) ZnO

(5) NiO

Choose the correct answer from the options given below

(1) 3, 4 only

(2) 2 only

(3) 1, 2, 5 Only

(4) 1, 2 only

Q43. The interhalogen compound formed from the reaction of bromine with excess of fluorine is a

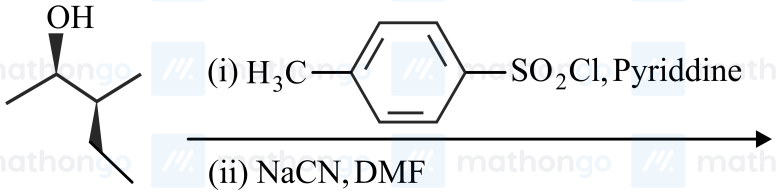
(1) hypohalite

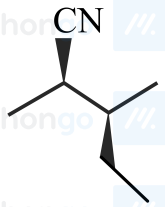
(2) halate

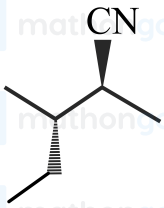
(3) perhalate

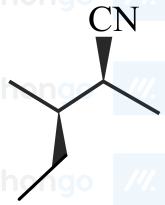
(4) halite

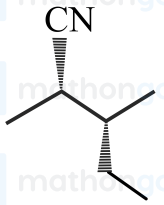
Q44. Most stable product of the following reaction is



(1) 

(2) 

(3) 

(4) 

Q45. Given below are two statements :

Statement I : On heating with $KHSO_4$, glycerol is dehydrated and acrolein is formed.

Statement II : Acrolein has fruity odour and can be used to test glycerol's presence.

Choose the correct option.

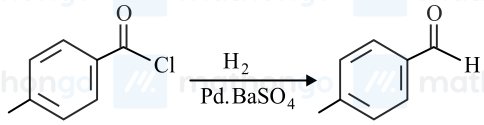
(1) Both Statement I and Statement II are correct.

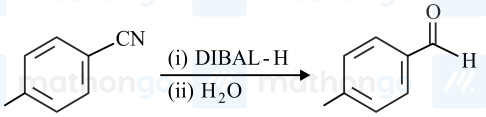
(2) Both Statement I and Statement II are incorrect

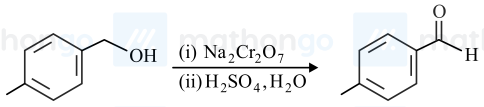
(3) Statement I is correct but Statement II is incorrect

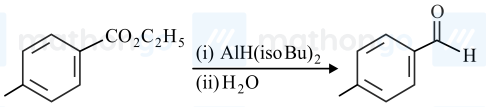
(4) Statement I is incorrect but Statement II is correct

Q46. Which one of the following reactions does not represent correct combination of substrate and product under the given conditions?

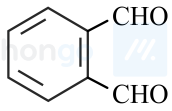
(1) 

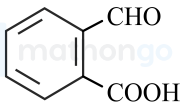
(2) 

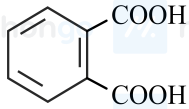
(3) 

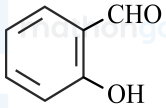
(4) 

Q47. An organic compound 'A' on reaction with NH_3 followed by heating gives compound B. Which on further strong heating gives compound C $C_8H_5NO_2$. Compound C on sequential reaction with ethanolic KOH, alkyl chloride and hydrolysis with alkali gives a primary amine. The compound A is

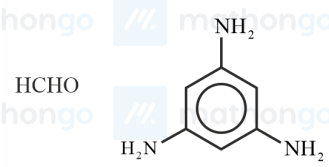
(1) 

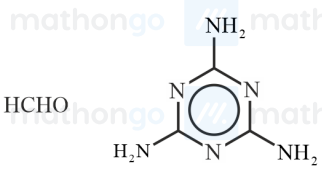
(2) 

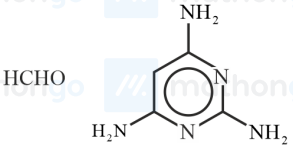
(3) 

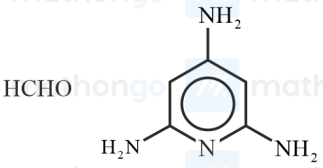
(4) 

Q48. Melamine polymer is formed by the condensation of

(1) 

(2) 

(3) 

(4) 

Q49. Drugs used to bind to receptors, inhibiting its natural function and blocking a message are called
(1) antagonists. (2) agonists.
(3) allosteric. (4) lead compounds.

Q50. During the denaturation of proteins, which of these structures will remain intact ?
(1) Primary (2) Secondary
(3) Tertiary (4) Quarternary

Q51. Among the following species N_2, $N_2^+, N_2^-, N_2^{2-}, O_2, O_2^+, O_2^-, O_2^{2-}$ the number of species showing diamagnetism is

Q52. The pressure of a moist gas at $27°C$ is 4 atm. The volume of the container is doubled at the same temperature. The new pressure of the moist gas is ... $\times 10^{-1}$ atm. (Nearest integer)
(Given: The vapour pressure of water at $27°C$ is 0.4 atm)

Q53. The enthalpy of combustion of propane, graphite and dihydrogen at 298 K are: -2220.0 kJ mol^{-1}, -393.5 kJ mol^{-1} and -285.8 kJ mol^{-1} respectively. The magnitude enthalpy of formation of propane C_3H_8 is _____ $kJmol^{-1}$. (Nearest integer)

Q54. While estimating the nitrogen present in an organic compound by Kjeldahl's method, the ammonia evolved from 0.25 g of the compound neutralized 2.5 mL of $2MH_2SO_4$. The percentage of nitrogen present in organic compound is _____ .

Q55. The number of sp^3 hybridised carbons in an acyclic neutral compound with molecular formula C_4H_5N is

Q56. The cell potential for $ZnZn^{2+}(aq)\|Sn^{x+}Sn$ is $0.801V$ at 298 K. The reaction quotient for the above reaction is 10^{-2}. The number of electrons involved in the given electrochemical cell reaction is _____ .
(Given $E^0_{Zn^{2+}|Zn} = -0.763$ V, $E^0_{Sn^{x+}|Sn} = +0.008$ V and $\frac{2.303RT}{F} = 0.06$ V)

Q57. The half life for the decomposition of gaseous compound A is 240 s when the gaseous pressure was 500 Torr initially. When the pressure was 250 Torr, the half life was found to be 4.0 min. The order of the reaction is _____ (Nearest integer)

Q58. Among Co^{3+}, Ti^{2+}, V^{2+} and Cr^{2+} ions, one if used as a reagent cannot liberate H_2 from dilute mineral acid solution, its spin-only magnetic moment in gaseous state is _____ B.M. (Nearest integer)

Q59. Consider the following metal complexes :

$CoNH_3^{3+}$

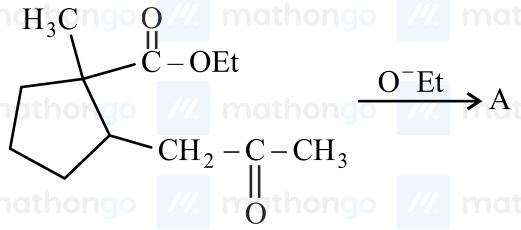
$CoClNH_3{}_5^{2+}$

$Co(CN)_6^{3-}$

$CoNH_3{}_5H_2O^{3+}$

The spin-only magnetic moment value of the complex that absorbs light with shortest wavelength is B.M. (Nearest integer)

Q60. In the given reaction



(Where Et is $-C_2H_5$)

The number of chiral carbon/s in product A is

Q61. If $\alpha, \beta, \gamma, \delta$ are the roots of the equation $x^4 + x^3 + x^2 + x + 1 = 0$, then $\alpha^{2021} + \beta^{2021} + \gamma^{2021} + \delta^{2021}$ is equal to

(1) 4 (2) 1

(3) -4 (4) -1

Q62. For $n \in N$, let $S_n = z \in C: z - 3 + 2i = \frac{n}{4}$ and $T_n = z \in C: z - 2 + 3i = \frac{1}{n}$. Then the number of elements in the set $n \in N: S_n \cap T_n = \phi$ is

(1) 0 (2) 2

(3) 3 (4) 4

Q63. The number of solutions of $\cos x = \sin x$, such that $-4\pi \leq x \leq 4\pi$ is

(1) 4 (2) 6

(3) 8 (4) 12

Q64. A line, with the slope greater than one, passes through the point $A4, 3$ and intersects the line $x - y - 2 = 0$ at the point B. If the length of the line segment AB is $\frac{\sqrt{29}}{3}$, then B also lies on the line

(1) $2x + y = 9$ (2) $3x - 2y = 7$

(3) $x + 2y = 6$ (4) $2x - 3y = 3$

Q65. Let the locus of the centre $\alpha, \beta, \quad \beta > 0$, of the circle which touches the circle $x^2 + y - 1^2 = 1$ externally and also touches the x-axis be L. Then the area bounded by L and the line $y = 4$ is

(1) $\frac{32\sqrt{2}}{3}$ (2) $\frac{40\sqrt{2}}{3}$

(3) $\frac{64}{3}$ (4) $\frac{32}{3}$

Q66. If $\lim_{n \to \infty} \sqrt{n^2 - n - 1} + n\alpha + \beta = 0$ then $8\alpha + \beta$ is equal to

(1) 4 (2) -8
(3) -4 (4) 8

Q67. Which of the following statements is a tautology?
(1) $\sim p \vee q \Rightarrow p$ (2) $p \Rightarrow \sim p \vee q$
(3) $\sim p \vee q \Rightarrow q$ (4) $q \Rightarrow \sim p \vee q$

Q68. A tower PQ stands on a horizontal ground with base Q on the ground. The point R divides the tower in two parts such that $QR = 15\text{m}$. If from a point A on the ground the angle of elevation of R is $60°$ and the part PR of the tower subtends an angle of $15°$ at A, then the height of the tower is
(1) $52\sqrt{3} + 3\text{m}$ (2) $5\sqrt{3} + 3\text{m}$
(3) $10\sqrt{3} + 1\text{m}$ (4) $102\sqrt{3} + 1\text{m}$

Q69. The number of $\theta \in 0, 4\pi$ for which the system of linear equations
$3\sin 3\theta x - y + z = 2$
$3\cos 2\theta x + 4y + 3z = 3$
$6x + 7y + 7z = 9$ has no solution is
(1) 6 (2) 7
(3) 8 (4) 9

Q70. The total number of functions, $f: 1, 2, 3, 4 \rightarrow 1, 2, 3, 4, 5, 6$ such that $f1 + f2 = f3$, is equal to
(1) 60 (2) 90
(3) 108 (4) 126

Q71. If the absolute maximum value of the function $fx = x^2 - 2x + 7e^{4x^3 - 12x^2 - 180x + 31}$ in the interval $-3, 0$ is $f\alpha$, then
(1) $\alpha = 0$ (2) $\alpha = -3$
(3) $\alpha \in -1, 0$ (4) $\alpha \in -3, -1$

Q72. The curve $yx = ax^3 + bx^2 + cx + 5$ touches the x-axis at the point $P-2, 0$ and cuts the y-axis at the point \$\mathrm{Q}\$, where y' is equal to 3. Then the local maximum value of yx is
(1) $\frac{27}{4}$ (2) $\frac{29}{4}$
(3) $\frac{37}{4}$ (4) $\frac{9}{2}$

Q73. For any real number x, let x denote the largest integer less than or equal to x. Let f be a real-valued function defined on the interval $-10, 10$ by

$$fx = \begin{cases} x - x, & \text{if } x \text{ is odd} \\ 1 + x - x, & \text{if } x \text{ is even} \end{cases}$$

Then, the value of $\frac{\pi^2}{10}\int_{-10}^{10} fx \cos\pi x dx$ is
(1) 4 (2) 2
(3) 1 (4) 0

Q74. The area of the region given by $A = x, y: x^2 \leq y \leq \min x + 2, 4 - 3x$ is
(1) $\frac{31}{8}$ (2) $\frac{17}{6}$
(3) $\frac{19}{6}$ (4) $\frac{27}{8}$

Q75. The slope of the tangent to a curve C: $y = yx$ at any point (x, y) on it is $\frac{2e^{2x} - 6e^{-x} + 9}{2 + 9e^{-2x}}$. If C passes through the points $0, \frac{1}{2} + \frac{\pi}{2\sqrt{2}}$ and $\alpha, \frac{1}{2}e^{2\alpha}$ then e^{α} is equal to

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

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

Q76. The general solution of the differential equation $x - y^2dx + y5x + y^2dy = 0$ is

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

(3) $y^2 + x^3 = C2y^2 + x^4$ (4) $y^2 + 2x^3 = C2y^2 + x^4$

Q77. Let ABC be a triangle such that $\overrightarrow{BC} = \vec{a}, \overrightarrow{CA} = \vec{b}, \overrightarrow{AB} = \vec{c}, \vec{a} = 6\sqrt{2}, \vec{b} = 2\sqrt{3}$ and $\vec{b} \cdot \vec{c} = 12$ Consider the statements :

$S1$: $\vec{a} \times \vec{b} + \vec{c} \times \vec{b} - \vec{c} = 62\sqrt{2} - 1$

$S2$: $\angle ABC = \cos^{-1}\sqrt{\frac{2}{3}}$. Then

(1) both $S1$ and $S2$are true (2) only $S1$ is true

(3) only $S2$ is true (4) both $S1$ and $S2$ are false

Q78. Let P be the plane containing the straight line $\frac{x-3}{9} = \frac{y+4}{-1} = \frac{z-7}{-5}$ and perpendicular to the plane containing the straight lines $\frac{x}{2} = \frac{y}{3} = \frac{z}{5}$ and $\frac{x}{3} = \frac{y}{7} = \frac{z}{8}$. If d is the distance of P from the point $2, -5, 11$, then d^2 is equal to

(1) $\frac{147}{2}$ (2) 96

(3) $\frac{32}{3}$ (4) 54

Q79. If the sum and the product of mean and variance of a binomial distribution are 24 and 128 respectively, then the probability of one or two successes is :

(1) $\frac{33}{2^{32}}$ (2) $\frac{33}{2^{29}}$

(3) $\frac{33}{2^{28}}$ (4) $\frac{33}{2^{27}}$

Q80. If the numbers appeared on the two throws of a fair six faced die are α and β, then the probability that $x^2 + \alpha x + \beta > 0$, for all $x \in R$, is

(1) $\frac{17}{36}$ (2) $\frac{4}{9}$

(3) $\frac{1}{2}$ (4) $\frac{19}{36}$

Q81. Let a, b be two non-zero real numbers. If p and r are the roots of the equation $x^2 - 8ax + 2a = 0$ and q and s are the roots of the equation $x^2 + 12bx + 6b = 0$, such that $\frac{1}{p}, \frac{1}{q}, \frac{1}{r}, \frac{1}{s}$ are in A.P., then $a^{-1} - b^{-1}$ is equal to _____ .

Q82. The letters of the word 'MANKIND' are written in all possible orders and arranged in serial order as in an English dictionary. Then the serial number of the word 'MANKIND' is _____ .

Q83. Let $a_1 = b_1 = 1, a_n = a_{n-1} + 2$ and $b_n = a_n + b_{n-1}$ for every natural number $n \geq 2$. Then $\sum_{n=1}^{15} a_n \cdot b_n$ is equal to _____ .

Q84. If the maximum value of the term independent of t in the expansion of $t^2x^{\frac{1}{5}} + \frac{1-x^{\frac{1}{10}}}{t}^{15}$, $x \geq 0$, is K, then 8 K is equal to _____ .

Q85. The sum of diameters of the circles that touch (i) the parabola $75x^2 = 645y - 3$ at the point $\frac{8}{5}, \frac{6}{5}$ and (ii) the y-axis, is equal to _____ .

Q86. Let the equation of two diameters of a circle $x^2 + y^2 - 2x + 2fy + 1 = 0$ be $2px - y = 1$ and $2x + py = 4p$. Then the slope $m \in 0, \infty$ of the tangent to the hyperbola $3x^2 - y^2 = 3$ passing through the centre of the circle is equal to _____.

Q87. Let $A = \begin{matrix} 2 & -1 & -1 \\ 1 & 0 & -1 \\ 1 & -1 & 0 \end{matrix}$ and $B = A - I$. If $\omega = \frac{\sqrt{3}i - 1}{2}$, then the number of elements in the set $n \in 1, 2, \ldots, 100: A^n + \omega B^n = A + B$ is equal to _____ .

Q88. Let $fx = \begin{matrix} 4x^2 - 8x + 5, & \text{if } 8x^2 - 6x + 1 \geq 0 \\ 4x^2 - 8x + 5, & \text{if } 8x^2 - 6x + 1 < 0 \end{matrix}$, where α denotes the greatest integer less than or equal to α. Then the number of points in R where f is not differentiable is _____ .

Q89. If $\lim\limits_{n \to \infty} \frac{n + 1^{k-1}}{n^{k+1}} (nk + 1) + (nk + 2) + \ldots + nk + n = 33$. $\lim\limits_{n \to \infty} \frac{1}{n^{k+1}} \cdot 1^k + 2^k + 3^k + \ldots + n^k$, then the integral value of k is equal to _____ .

Q90. The line of shortest distance between the lines $\frac{x-2}{0} = \frac{y-1}{1} = \frac{z}{1}$ and $\frac{x-3}{2} = \frac{y-5}{2} = \frac{z-1}{1}$ makes an angle of $\sin^{-1}\sqrt{\frac{2}{27}}$ with the plane $P: ax - y - z = 0, \quad a > 0$. If the image of the point $1, 1, -5$ in the plane P is α, β, γ, then $\alpha + \beta - \gamma$ is equal to _____ .

ANSWER KEYS

1. (2)	**2.** (1)	**3.** (1)	**4.** (2)	**5.** (4)	**6.** (2)	**7.** (2)	**8.** (1)
9. (1)	**10.** (1)	**11.** (2)	**12.** (2)	**13.** (4)	**14.** (3)	**15.** (2)	**16.** (1)
17. (1)	**18.** (3)	**19.** (1)	**20.** (1)	**21.** (3)	**22.** (3)	**23.** (5)	**24.** (60)
25. (20)	**26.** (45)	**27.** (4)	**28.** (4)	**29.** (3)	**30.** (150)	**31.** (3)	**32.** (3)
33. (3)	**34.** (3)	**35.** (1)	**36.** (1)	**37.** (3)	**38.** (2)	**39.** (4)	**40.** (3)
41. (3)	**42.** (2)	**43.** (2)	**44.** (2)	**45.** (3)	**46.** (3)	**47.** (3)	**48.** (2)
49. (1)	**50.** (1)	**51.** (2)	**52.** (22)	**53.** (104)	**54.** (56)	**55.** (1)	**56.** (4)
57. (1)	**58.** (5)	**59.** (0)	**60.** (2)	**61.** (4)	**62.** (4)	**63.** (3)	**64.** (3)
65. (3)	**66.** (3)	**67.** (4)	**68.** (1)	**69.** (2)	**70.** (2)	**71.** (2)	**72.** (1)
73. (1)	**74.** (2)	**75.** (2)	**76.** (1)	**77.** (3)	**78.** (3)	**79.** (3)	**80.** (1)
81. (38)	**82.** (1492)	**83.** (27560)	**84.** (6006)	**85.** (10)	**86.** (2)	**87.** (17)	**88.** (3)
89. (5)	**90.** (3)						