Q1. If R, X_L and X_C represent resistance, inductive reactance and capacitive reactance. Then which of the following is dimensionless:

(1) $R\ X_L\ X_C$ (2) $\frac{R}{\sqrt{X_L X_C}}$

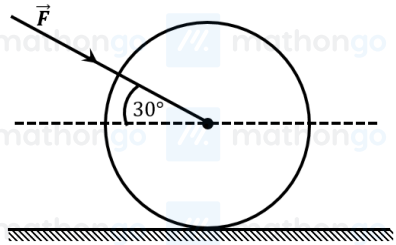
(3) $\frac{R}{X_L X_C}$ (4) $R\frac{X_L}{X_C}$

Q2. The initial speed of a projectile fired from ground is u. At the highest point during its motion, the speed of projectile is $\frac{\sqrt{3}}{2}u$. The time of flight of the projectile is:

(1) $\frac{u}{2g}$ (2) $\frac{u}{g}$

(3) $\frac{2u}{g}$ (4) $\frac{\sqrt{3}u}{g}$

Q3. As shown in figure, a 70 kg garden roller is pushed with a force of $\vec{F} = 200$ N at an angle of 30° with horizontal. The normal reaction on the roller is (Given $g = 10$ m s^{-2})



(1) $800\sqrt{2}$ N (2) 600 N

(3) 800 N (4) $200\sqrt{3}$ N

Q4. 100 balls each of mass m moving with speed v simultaneously strike a wall normally and reflected back with same speed, in time t s. The total force exerted by the balls on the wall is

(1) $\frac{100mv}{t}$ (2) $\frac{200mv}{t}$

(3) 200 mvt (4) $\frac{mv}{100t}$

Q5. At a certain depth d below surface of earth, value of acceleration due to gravity becomes four times that of its value at a height $3R$ above earth surface. Where R is Radius of earth (Take $R = 6400$ km). The depth d is equal to

(1) 5260 km (2) 640 km

(3) 2560 km (4) 4800 km

Q6. Spherical insulating ball and a spherical metallic ball of same size and mass are dropped from the same height. Choose the correct statement out of the following {Assume negligible air friction}

(1) Time taken by them to reach the earth's surface will be independent of the properties of their materials

(2) Insulating ball will reach the earth's surface earlier than the metal ball

(3) Both will reach the earth's surface simultaneously

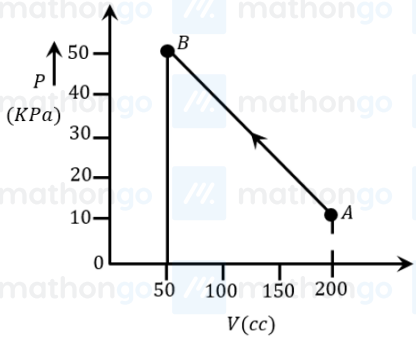
(4) Metal ball will reach the earth's surface earlier than the insulating ball

Q7. If 1000 droplets of water of surface tension 0.07 N m^{-1}. having same radius 1 mm each, combine to from a single drop. In the process the released surface energy is-

Take $\pi = \frac{22}{7}$

(1) 7.92×10^{-6} J (2) 7.92×10^{-4} J
(3) 9.68×10^{-4} J (4) 8.8×10^{-5} J

Q8. The pressure of a gas changes linearly with volume from A to B as shown in figure. If no heat is supplied to or extracted from the gas then change in the internal energy of the gas will be



(1) 6 J (2) Zero
(3) -4.5 J (4) 4.5 J

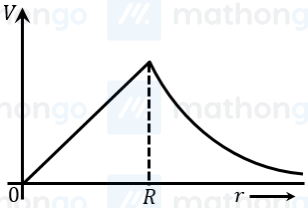
Q9. The correct relation between $\gamma = \frac{C_P}{C_V}$ and temperature T is :

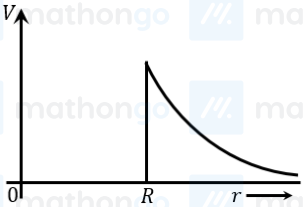
(1) $\gamma \propto \frac{1}{\sqrt{T}}$ (2) $\gamma \propto T^0$
(3) $\gamma \propto \frac{1}{T}$ (4) $\gamma \propto T$

Q10. The maximum potential energy of a block executing simple harmonic motion is 25 J. A is amplitude of oscillation. At $\frac{A}{2}$, the kinetic energy of the block is

(1) 37.5 J (2) 9.75 J
(3) 18.75 J (4) 12.5 J

Q11. Which of the following correctly represents the variation of electric potential (V) of a charged spherical conductor of radius (R) with radial distance (r) from the centre?

(1)


(2)


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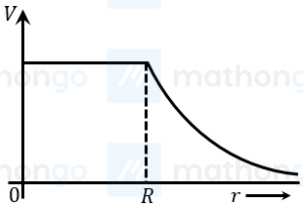
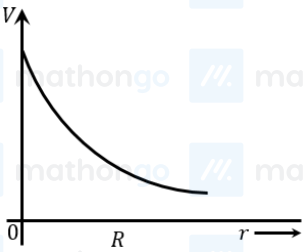


(4)


Q12. The drift velocity of electrons for a conductor connected in an electrical circuit is V_d. The conductor is now replaced by another conductor with same material and same length but double the area of cross-section. The applied voltage remains same. The new drift velocity of electrons will be

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

Q13. A bar magnet with a magnetic moment 5.0 A m^2 is placed in parallel position relative to a magnetic field of 0.4 T. The amount of required work done in turning the magnet form parallel to antiparallel position relative to the field direction is _____.
(1) 4 J (2) 1 J
(3) 2 J (4) Zero

Q14. A rod with circular cross-section area 2 cm^2 and length 40 cm is wound uniformly with 400 turns of an insulated wire. If a current of 0.4 A flows in the wire windings, the total magnetic flux produced inside windings is $4\pi \times 10^{-6}$ Wb. The relative permeability of the rod is
(Given : Permeability of vacuum $\mu_0 = 4\pi \times 10^{-7}$ N A^{-2})
(1) 12.5 (2) $\frac{32}{5}$
(3) 125 (4) $\frac{5}{16}$

Q15. Two polaroids A and B are placed in such a way that the pass-axis of polaroids are perpendicular to each other. Now, another polaroid C is placed between A and B bisecting angle between them. If intensity of unpolarised light is I_0 then intensity of transmitted light after passing through polaroid B will be :
(1) $\frac{I_0}{4}$ (2) $\frac{I_0}{2}$
(3) $\frac{I_0}{8}$ (4) Zero

Q16. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R
Assertion A : The beam of electrons shows wave nature and exhibit interference and diffraction.
Reason R : Davisson Germer Experimentally verified the wave nature of electrons.
In the light of the above statements. Choose the most appropriate answer from the options given below :
(1) A is correct but R is not correct (2) A is not correct but R is correct
(3) Both A and R are correct but R is Not the correct explanation of A (4) Both A and R are correct and R is the correct explanation of A

Q17. If a source of electromagnetic radiation having power 15 kW produces 10^{16} photons per second, the radiation belongs to a part of spectrum is :
(Take Planck constant $h = 6 \times 10^{-34}$ J s)
(1) Micro waves (2) Ultraviolet rays
(3) Gamma rays (4) Radio waves

Q18. A free neutron decays into a proton but a free proton does not decay into neutron. This is because
(1) neutron is an uncharged particle (2) proton is a charged particle
(3) neutron is a composite particle made of a proton and an electron (4) neutron has larger rest mass than proton

Q19. The effect of increase in temperature on the number of electrons in conduction band (n_e) and resistance of a semiconductor will be as:

(1) Both n_e and resistance decrease
(2) Both n_e and resistance increase
(3) n_e increases, resistance decreases
(4) n_e decreases, resistance increases

Q20. The amplitude of $15\sin(1000\pi t)$ is modulated by $10\sin(4\pi t)$ signal. The amplitude modulated signal contains frequency (ies) of

(A) 500 Hz
(B) 2 Hz
(C) 250 Hz
(D) 498 Hz
(E) 502 Hz

Choose the correct answer from the options given below:

(1) A only
(2) A, D and E only
(3) B only
(4) A and B only

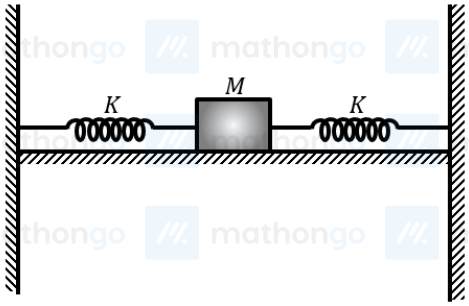
Q21. The speed of a swimmer is 4 km h^{-1} in still water. If the swimmer makes his strokes normal to the flow of river of width 1 km, he reaches a point 750 m down the stream on the opposite bank. The speed of the river water is _____ km h^{-1}.

Q22. A lift of mass $M = 500$ kg is descending with speed of 2 m s^{-1}. Its supporting cable begins to slip thus allowing it to fall with a constant acceleration of 2 m s^{-2}. The kinetic energy of the lift at the end of fall through to a distance of 6 m will be _____ kJ.

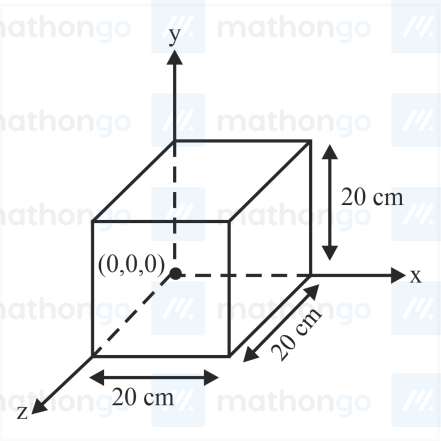
Q23. A solid sphere of mass 1 kg rolls without slipping on a plane surface. Its kinetic energy is 7×10^{-3} J. The speed of the centre of mass of the sphere is _____ cm s^{-1}.

Q24. A thin rod having a length of 1 m and area of cross-section 3×10^{-6} m^2 is suspended vertically from one end. The rod is cooled from 210°C to 160°C. After cooling, a mass M is attached at the lower end of the rod such that the length of rod again becomes 1 m. Young's modulus and coefficient of linear expansion of the rod are 2×10^{11} N m^{-2} and 2×10^{-5} K^{-1}, respectively. The value of M is _____ kg. (Take $g = 10$ m s^{-2})

Q25. In the figure given below. a block of mass $M = 490$ g placed on a frictionless table is connected with two springs having same spring constant ($K = 2$ N m^{-1}). If the block is horizontally displaced through X m then the number of complete oscillations it will make in 14π seconds will be _____.



Q26. Expression for an electric field is given by $\vec{E} = 4000\ x^2\ \hat{i}$ V m^{-1}. The electric flux through the cube of side 20 cm when placed in electric field (as shown in the figure) is _____ V cm.

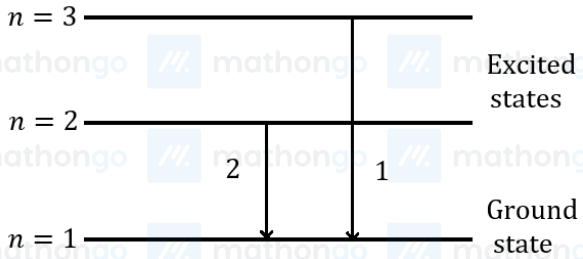


Q27. Two identical cells, when connected either in parallel or in series gives same current in an external resistance 5 Ω. The internal resistance of each cell will be _____ Ω.

Q28. An inductor of 0.5 mH, a capacitor of 20 μF and resistance of 20 Ω are connected in series with a 220 V ac source. If the current is in phase with the emf, the amplitude of current of the circuit is $\sqrt{x}$ A. The value of x is-

Q29. In a medium the speed of light wave decreases to 0.2 times to its speed in free space. The ratio of relative permittivity to the refractive index of the medium is x: 1. The value of x is _____.
(Given speed of light in free space $= 3 \times 10^8$ m s^{-1} and for the given medium $\mu_r = 1$)

Q30. For hydrogen atom, λ_1 and λ_2 are the wavelengths corresponding to the transitions 1 and 2 respectively as shown in figure. The ratio of λ_1 and λ_2 is $\frac{x}{32}$. The value of x is _____.



Q31. Which transition in the hydrogen spectrum would have the same wavelength as the Balmer type transition from n = 4 to n = 2 of He^+ spectrum

(1) n = 2 to n = 1
(2) n = 1 to n = 3
(3) n = 1 to n = 2
(4) n = 3 to n = 4

Q32. The correct increasing order of the ionic radii is

(1) $Cl^- < Ca^{2+} < K^+ < S^{2-}$
(2) $K^+ < S^{2-} < Ca^{2+} < Cl^-$
(3) $S^{2-} < Cl^- < Ca^{2+} < K^+$
(4) $Ca^{2+} < K^+ < Cl^- < S^{2-}$

Q33. Match List I with List II

List I	List II
A. XeF_4	I.See-saw
B. SF_4	II. Square planar

C. NH_4^+ III. Bent T - shaped

D. BrF_3 IV. Tetrahedral

Choose the correct answer from the options given below :

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

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

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

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

Q34. H_2O_2 acts as a reducing agent in

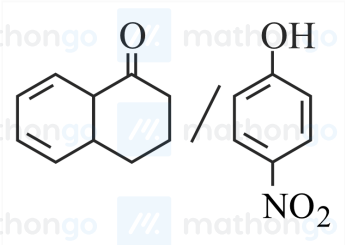
(1) $2NaOCl + H_2O_2 \rightarrow 2NaCl + H_2O + O_2$

(2) $2Fe^{2+} + 2H^+ + H_2O_2 \rightarrow 2Fe^{3+} + 2H_2O$

(3) $Mn^{2+} + 2H_2O_2 \rightarrow MnO_2 + 2H_2O$

(4) $Na_2\ S + 4H_2O_2 \rightarrow Na_2SO_4 + 4H_2O$

Q35. Match items of column I and II

Column I (Mixture of compounds)	Column II (Separation Technique)
A. H_2O / CH_2Cl_2	i. Crystallization
B. 	ii. Differential solvent extraction
C. Kerosene/Naphthalene	iii. Column chromatography
D. $C_6H_{12}O_6$ / NaCl	iv. Fractional Distillation

(1) A - (iii), B - (iv), C - (ii), D - (i)

(2) A - (ii), B - (iii), C - (iv), D - (i)

(3) A - (i), B - (iii), C - (ii), D - (iv)

(4) A - (ii), B - (iv), C - (i), D - (iii)

Q36. Choose the correct set of reagents for the following conversion

trans Ph - CH = CH - CH_3 → cis Ph - CH = CH - CH_3

(1) Br_2, alc KOH, $NaNH_2$, $NaLiqNH_3$

(2) Br_2, alc KOH, $NaNH_2$, H_2 Lindlar Catalyst

(3) Br_2, aqKOH, $NaNH_2$, H_2 Lindlar Catalyst

(4) Br_2, aq KOH, $NaNH_2$, $NaLiqNH_3$

Q37. Which one of the following statements is correct for electrolysis of brine solution?

(1) Cl_2 is formed at cathode

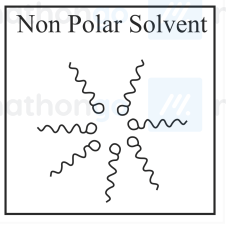
(2) O_2 is formed at cathode

(3) H_2 is formed at anode

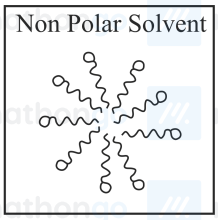
(4) OH^- is formed at cathode

Q38. Adding surfactants in non polar solvent, the micelles structure will look like

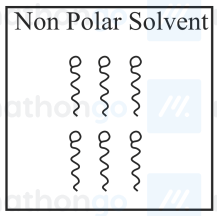
(a)



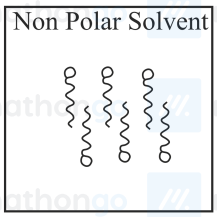
(b)



(c)



(d)



(1) b (2) c
(3) a (4) d

Q39. The methods NOT involved in concentration of ore are
(A) Liquation
(B) Leaching
(C) Electrolysis
(D) Hydraulic washing
(E) Froth floatation
Choose the correct answer from the options given below:
(1) B, D and C only (2) C, D and E only
(3) A and C only (4) B, D and E only

Q40. Identify X, Y and Z in the following reaction. (Equation not balanced)

$$\dot{ClO} + NO_2 \rightarrow \underline{X} \xrightarrow{H_2O} \underline{Y} + \underline{Z}$$

(1) $X = ClONO_2$, $Y = HOCl$, $Z = NO_2$ (2) $X = ClNO_2$, $Y = HCl$, $Z = HNO_3$
(3) $X = ClONO_2$, $Y = HOCl$, $Z = HNO_3$ (4) $X = ClNO_3$, $Y = Cl_2$, $Z = NO_2$

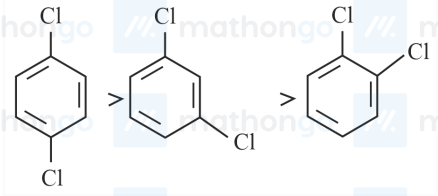
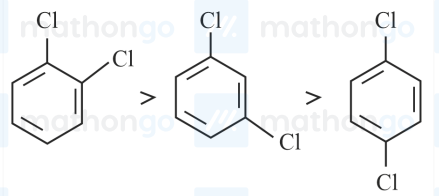
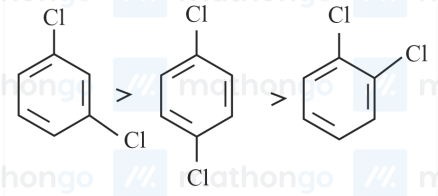
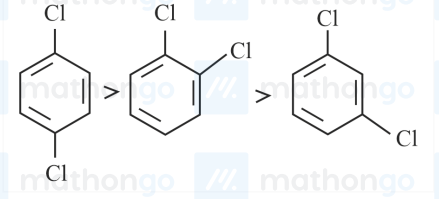
Q41. When Cu^{2+} ion is treated with KI, a white precipitate, X appears in solution. The solution is titrated with sodium thiosulphate, the compound Y is formed. X and Y respectively are
(1) $X = Cu_2I_2$, $Y = Na_2S_4O_5$ (2) $X = Cu_2I_2$, $Y = Na_2S_4O_6$
(3) $X = CuI_2$, $Y = Na_2S_4O_3$ (4) $X = CuI_2$, $Y = Na_2S_4O_6$

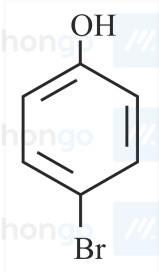
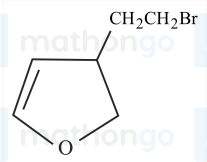
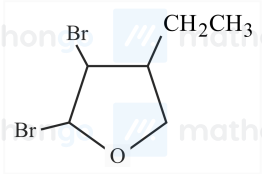
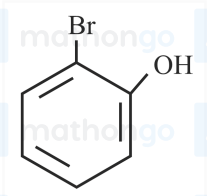
Q42. The correct order of basicity of oxides of vanadium is

(1) $V_2O_3 > V_2O_4 > V_2O_5$ (2) $V_2O_3 > V_2O_5 > V_2O_4$
(3) $V_2O_5 > V_2O_4 > V_2O_3$ (4) $V_2O_4 > V_2O_3 > V_2O_5$

Q43. $Nd^{2+} =$ _____
(1) $4f^2 6s^2$ (2) $4f^4$
(3) $4f^3$ (4) $4f^4 6s^2$

Q44. Cobalt chloride when dissolved in water forms pink colored complex X which has octahedral geometry. This solution on treating with cone HCl forms deep blue complex, Y which has a Z geometry. X, Y and Z, respectively, are
(1) $X = CoH_2O_6^{2+}$, $Y = CoCl_4^{2-}$, $Z =$ Tetrahedral (2) $X = CoH_2O_6^{2+}$, $Y = CoCl_6^{3-}$, $Z =$ Octahedral
(3) $X = CoH_2O_6^{3+}$, $Y = CoCl_6^{3-}$, $Z =$ Octahedral (4) $X = CoH_2O_4Cl_2^{+}$, $Y = CoCl_4^{2-}$, $Z =$ Tetrahedral

Q45. The correct order of melting point of dichlorobenzenes is
(1) 
(2) 
(3) 
(4) 

Q46. An organic compound ' A ' with empirical formula C_6H_6O gives sooty flame on burning. Its reaction with bromine solution in low polarity solvent results in high yield of B . B is
(1) 
(2) 
(3) 
(4) 

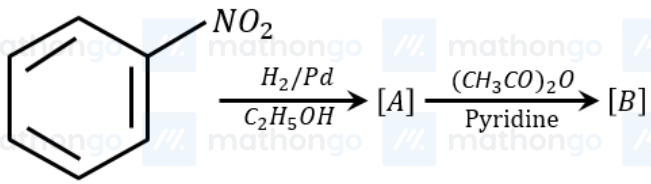
Q47. Consider the following reaction

$$\text{Propanal} + \text{Methanal} = \xrightarrow[(ii)\ \Delta\ (iii)\ NaCN\ (iv)\ H_3O^+]{(i)\ \text{dil. NaOH}} \underset{(C_5H_8O_3)}{\text{Product B}}$$

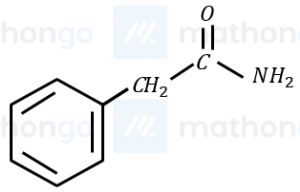
The correct statement for product B is. It is

(1) optically active and adds one mole of bromine
(2) racemic mixture and is neutral
(3) racemic mixture and gives a gas with saturated $NaHCO_3$ solution
(4) optically active alcohol and is neutrall

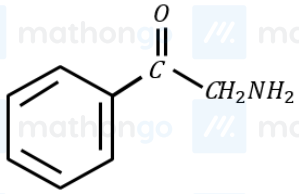
Q48.



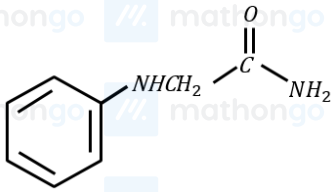
(1)



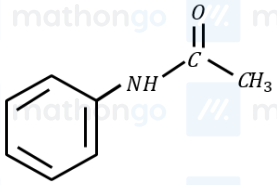
(2)



(3)



(4)



Q49. Which of the following artificial sweeteners has the highest sweetness value in comparison to cane sugar?
(1) Aspartame
(2) Sucralose
(3) Alitame
(4) Saccharin

Q50. A protein 'X' with molecular weight of $70,000$ u, on hydrolysis gives amino acids. One of these amino acid is

(1) $NH_2-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2CH_2COOH$

(2) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-\underset{\displaystyle NH_2}{\underset{|}{CH}}-COOH$

(3) $CH_3-\underset{\displaystyle NH_2}{\underset{|}{\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH}}-CH_2COOH$

(4) $CH_3-\underset{\displaystyle NH_2}{\underset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_2}}-CH_2COOH$

Q51. On complete combustion, 0.492 g of an organic compound gave 0.792 g of CO_2. The % of carbon in the organic compound is (Nearest integer)

Q52. Zinc reacts with hydrochloric acid to give hydrogen and zinc chloride. The volume of hydrogen gas produced at STP from the reaction of 11.5 g of zinc with excess HCl is L (Nearest integer)
(Given : Molar mass of Zn is 65.4 g mol^{-1} and Molar volume of H_2 at STP $= 22.7$ L)

Q53. The enthalpy change for the conversion of $\frac{1}{2}Cl_2$ (g) to $Cl^-(aq)$ is (-) kJmol^{-1} (Nearest integer)

Given : $\Delta_{dis}\, H^0_{Cl_{2(\ g)}} = 240 kJmol^{-1}$.

$\Delta_{eg}H^o_{Cl(g)} = -350 kJmol^{-1}$,

$\Delta_{hyd}H^o_{Cl^-_{(g)}} = -380 kJmol^{-1}$

Q54. For reaction: $SO_2(\ g) + \frac{1}{2}O_2(\ g) \rightleftharpoons SO_3(\ g)$ $K_P = 2 \times 10^{12}$ at 27°C and 1 atm pressure. The K_c for the same reaction is $\times 10^{13}$. (Nearest integer)

(Given $R = 0.082$ L atm K^{-1} mol^{-1})

Q55. The total pressure of a mixture of non-reacting gases $X(0.6\ g)$ and $Y(0.45\ g)$ in a vessel is 740 mm of Hg. The partial pressure of the gas X is mm of Hg. (Nearest Integer)

(Given : molar mass $X = 20$ and $Y = 45$ g mol^{-1})

Q56. At 27°C, a solution containing 2.5 g of solute in 250.0 mL of solution exerts an osmotic pressure of 400 Pa. The molar mass of the solute is g mol^{-1} (Nearest integer)

(Given : $R = 0.083$ L bar $^{-1}$ mol^{-1})

Q57. The logarithm of equilibrium constant for the reaction $Pd^{2+} + 4Cl^- \rightleftharpoons PdCl_4^{2-}$ is (Nearest integer)

Given: $\frac{2.303RT}{F} = 0.06$ V

$Pd^{2+}_{(aq)} + 2e^- \rightleftharpoons Pd(s)$ $E^o = 0.83$ V

$PdCl_4^{2-}(aq) + 2e^- \rightleftharpoons Pd(s) + 4Cl^-(aq)$

$E^o = 0.65$ V

Q58. $A \rightarrow B$

The rate constants of the above reaction at 200 K and 300 K are 0.03 min^{-1} and 0.05 min^{-1} respectively. The activation energy for the reaction is J (Nearest integer)

(Given : In $10 = 2.3$

$R = 8.3$ J K^{-1} mol^{-1}

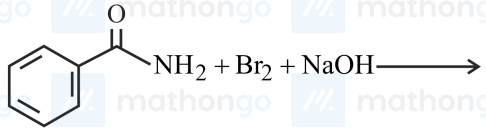
$\log 5 = 0.70$

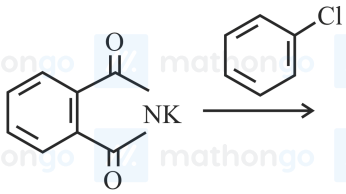
$\log 3 = 0.48$

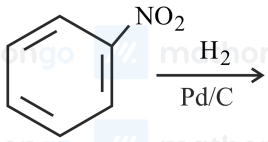
$\log 2 = 0.30$

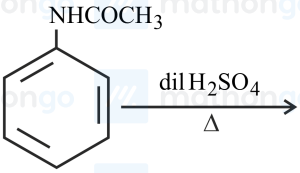
Q59. The oxidation sate of phosphorus in hypophosphoric acid is

Q60. How many of the transformation given below would result in aromatic amines?

(1) 

(2) 

(3) 

(4) 

Q61. The number of real roots of the equation $\sqrt{x^2 - 4x + 3} + \sqrt{x^2 - 9} = \sqrt{4x^2 - 14x + 6}$, is:

(1) 0 (2) 1

(3) 3 (4) 2

Q62. For all $z \in C$ on the curve $C_1: |z| = 4$, let the locus of the point $z + \frac{1}{z}$ be the curve C_2. Then

(1) the curves C_1 and C_2 intersect at 4 points (2) the curves C_1 lies inside C_2

(3) the curves C_1 and C_2 intersect at 2 points (4) the curves C_2 lies inside C_1

Q63. If the sum and product of four positive consecutive terms of a G.P., are 126 and 1296, respectively, then the sum of common ratios of all such GPs is

(1) 7 (2) $\frac{9}{2}$

(3) 3 (4) 14

Q64. Let a circle C_1 be obtained on rolling the circle $x^2 + y^2 - 4x - 6y + 11 = 0$ upwards 4 units on the tangent T to it at the point $3, 2$. Let C_2 be the image of C_1 in T. Let A and B be the centers of circles C_1 and C_2 respectively, and M and N be respectively the feet of perpendiculars drawn from A and B on the x-axis. Then the area of the trapezium AMNB is:

(1) $22 + \sqrt{2}$ (2) $41 + \sqrt{2}$

(3) $3 + 2\sqrt{2}$ (4) $21 + \sqrt{2}$

Q65. If the maximum distance of normal to the ellipse $\frac{x^2}{4} + \frac{y^2}{b^2} = 1, b < 2$, from the origin is 1 , then the eccentricity of the ellipse is:

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

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

Q66. Consider:

S1: $p \Rightarrow q \vee p \wedge \sim q$ is a tautology.

S2: $\sim p \Rightarrow \sim q \wedge \sim p \vee q$ is a contradiction.

Then

(1) only S2 is correct (2) both S1 and S2 are correct

(3) both S1 and S2 are wrong (4) only S1 is correct

Q67. Let R be a relation on $N \times N$ defined by a, bRc, d if and only if $adb - c = bca - d$. Then R is

(1) symmetric but neither reflexive nor transitive (2) transitive but neither reflexive nor symmetric

(3) reflexive and symmetric but not transitive (4) symmetric and transitive but not reflexive

Q68. Let $A = \begin{matrix} 1 & 0 & 0 \\ 0 & 4 & -1 \\ 0 & 12 & -3 \end{matrix}$. Then the sum of the diagonal elements of the matrix $A + I^{11}$ is equal to:

(1) 6144 (2) 4094

(3) 4097 (4) 2050

Q69. For the system of linear equations

$x + y + z = 6$

$\alpha x + \beta y + 7z = 3$

$x + 2y + 3z = 14$

which of the following is NOT true ?

(1) If $\alpha = \beta = 7$, then the system has no solution (2) If $\alpha = \beta$ and $\alpha \neq 7$ then the system has a unique solution.

(3) There is a unique point (α, β) on the line $x + 2y + 18 = 0$ for which the system has infinitely many solutions (4) For every point $(\alpha, \beta) \neq (7, 7)$ on the line $x - 2y + 7 = 0$, the system has infinitely many solutions.

Q70. If $\sin^{-1}\frac{\alpha}{17} + \cos^{-1}\frac{4}{5} - \tan^{-1}\frac{77}{36} = 0, 0 < \alpha < 13$, then $\sin^{-1}\sin\alpha + \cos^{-1}\cos\alpha$ is equal to

(1) π (2) 16

(3) 0 (4) $16 - 5\pi$

Q71. Let $y = fx$ represent a parabola with focus $-\frac{1}{2}, 0$ and directrix $y = -\frac{1}{2}$. Then $S = x \in \mathbb{R}: \tan^{-1}\sqrt{fx} + \sin^{-1}\sqrt{fx+1} = \frac{\pi}{2}$:

(1) contains exactly two elements (2) contains exactly one element

(3) is an infinite set (4) is an empty set

Q72. If the domain of the function $fx = \frac{x}{1+x^2}$, where x is greatest integer $\leq x$, is $[2, 6)$, then its range is

(1) $\frac{5}{26}, \frac{2}{5} - \frac{9}{29}, \frac{27}{109}, \frac{18}{89}, \frac{9}{53}$ (2) $\frac{5}{26}, \frac{2}{5}$

(3) $\frac{5}{37}, \frac{2}{5} - \frac{9}{29}, \frac{27}{109}, \frac{18}{89}, \frac{9}{53}$ (4) $\frac{5}{37}, \frac{2}{5}$

Q73. Let $y = fx = \sin^3\frac{\pi}{3}\cos\frac{\pi}{3\sqrt{2}} - 4x^3 + 5x^2 + 1^{\frac{3}{2}}$. Then, at $x = 1$,

(1) $2y' + \sqrt{3}\pi^2 y = 0$ (2) $2y' + 3\pi^2 y = 0$

(3) $\sqrt{2}y' - 3\pi^2 y = 0$ (4) $y' + 3\pi^2 y = 0$

Q74. A wire of length 20 m is to be cut into two pieces. A piece of length ℓ_1 is bent to make a square of area A_1 and the other piece of length ℓ_2 is made into a circle of area A_2. If $2 A_1 + 3 A_2$ is minimum then $\pi\ell_1 : \ell_2$ is

equal to:

(1) 6: 1 (2) 3: 1

(3) 1: 6 (4) 4: 1

Q75. Let $\alpha \in 0,1$ and $\beta = \log_e 1 - \alpha$. Let $P_n x = x + \frac{x^2}{2} + \frac{x^3}{3} + \ldots . + \frac{x^n}{n}, x \in 0,1$. Then the integral $\int_0^\alpha \frac{t^{50}}{1-t} dt$ is equal to

(1) $\beta - P_{50}\alpha$ (2) $-\beta + P_{50}\alpha$

(3) $P_{50}\alpha - \beta$ (4) $\beta + P_{50}\alpha$

Q76. The value of $\int_{\frac{\pi}{3}}^{\frac{\pi}{2}} \frac{2+3\sin x}{\sin x 1+\cos x} dx$ is equal to

(1) $\frac{7}{2} - \sqrt{3} - \log_e \sqrt{3}$ (2) $-2 + 3\sqrt{3} + \log_e \sqrt{3}$

(3) $\frac{10}{3} - \sqrt{3} + \log_e \sqrt{3}$ (4) $\frac{10}{3} - \sqrt{3} - \log_e \sqrt{3}$

Q77. Let a differentiable function f satisfy $fx + \int_3^x \frac{ft}{t} dt = \sqrt{x+1}, x \geq 3$. Then $12f8$ is equal to:

(1) 34 (2) 19

(3) 17 (4) 1

Q78. Let $\vec{a} = 2\hat{i} + \hat{j} + \hat{k}$, and $\vec{b}$ and $\vec{c}$ be two nonzero vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{a} + \vec{b} - \vec{c}$ and $\vec{b} \cdot \vec{c} = 0$. Consider the following two statement:

A $\vec{a} + \lambda\vec{c} \geq \vec{a}$ for all $\lambda \in \mathbb{R}$.

B $\vec{a}$ and $\vec{c}$ are always parallel

(1) only (B) is correct (2) neither (A) nor (B) is correct

(3) only (A) is correct (4) both (A) and (B) are correct.

Q79. Let the shortest distance between the lines L: $\frac{x-5}{-2} = \frac{y-\lambda}{0} = \frac{z+\lambda}{1}, \lambda \geq 0$ and L_1: $x + 1 = y - 1 = 4 - z$ be $2\sqrt{6}$. If (α, β, γ) lies on L, then which of the following is NOT possible?

(1) $\alpha + 2\gamma = 24$ (2) $2\alpha + \gamma = 7$

(3) $2\alpha - \gamma = 9$ (4) $\alpha - 2\gamma = 19$

Q80. A bag contains 6 balls. Two balls are drawn from it at random and both are found to be black. The probability that the bag contains at least 5 black balls is

(1) $\frac{5}{7}$ (2) $\frac{2}{7}$

(3) $\frac{3}{7}$ (4) $\frac{5}{6}$

Q81. Let 5 digit numbers be constructed using the digits $0, 2, 3, 4, 7, 9$ with repetition allowed, and are arranged in ascending order with serial numbers. Then the serial number of the number 42923 is _____ .

Q82. Let $a_1, a_2, \ldots \ldots, a_n$ be in A.P. If $a_5 = 2a_7$ and $a_{11} = 18$, then $12\frac{1}{\sqrt{a_{10}} + \sqrt{a_{11}}} + \frac{1}{\sqrt{a_{11}} + \sqrt{a_{12}}} + \ldots . . \frac{1}{\sqrt{a_{17}} + \sqrt{a_{18}}}$ is equal to _____ .

Q83. Number of 4-digit numbers that are less than or equal to 2800 and either divisible by 3 or by 11 , is equal to _____ .

Q84. Let $\alpha > 0$, be the smallest number such that the expansion of $x^{\frac{2}{3}} + \frac{2}{x^3}^{30}$ has a term $\beta x^{-\alpha}, \beta \in N$. Then α is equal to _____ .

Q85. The remainder on dividing 5^{99} by 11 is _____ .

Q86. If the variance of the frequency distribution

x_i	2	3	4	5	6	7	8
Frequency f_i	3	6	16	α	9	5	6

is 3, then α is equal to

Q87. Let for $x \in R$, $fx = \frac{x+x}{2}$ and $gx = \begin{matrix} x, & x < 0 \\ x^2, & x \geq 0 \end{matrix}$. Then area bounded by the curve $y = fogx$ and the lines $y = 0, 2y - x = 15$ is equal to _____ .

Q88. Let $\vec{a}$ and $\vec{b}$ be two vector such that $\vec{a} = \sqrt{14}$, $\vec{b} = \sqrt{6}$ and $\vec{a} \times \vec{b} = \sqrt{48}$. Then $\vec{a} \cdot \vec{b}^2$ is equal to _____ .

Q89. Let the line $L: \frac{x-1}{2} = \frac{y+1}{-1} = \frac{z-3}{1}$ intersect the plane $2x + y + 3z = 16$ at the point P. Let the point Q be the foot of perpendicular from the point $R1, -1, -3$ on the line L. If α is the area of triangle PQR. then α^2 is equal to _____ .

Q90. Let θ be the angle between the planes $P_1 = \vec{r} \cdot \hat{i} + \hat{j} + 2\hat{k} = 9$ and $P_2 = \vec{r} \cdot 2\hat{i} - \hat{j} + \hat{k} = 15$. Let L be the line that meets P_2 at the point $4, -2, 5$ and makes an angle θ with the normal of P_2. If α is the angle between L and P_2 then $\tan^2\theta\cot^2\alpha$ is equal to _____ .

ANSWER KEYS

1. (2)	**2.** (2)	**3.** (3)	**4.** (2)	**5.** (4)	**6.** (2)	**7.** (2)	**8.** (4)
9. (2)	**10.** (3)	**11.** (3)	**12.** (1)	**13.** (1)	**14.** (3)	**15.** (3)	**16.** (4)
17. (3)	**18.** (4)	**19.** (3)	**20.** (2)	**21.** (3)	**22.** (7)	**23.** (10)	**24.** (60)
25. (20)	**26.** (640)	**27.** (5)	**28.** (242)	**29.** (5)	**30.** (27)	**31.** (1)	**32.** (4)
33. (4)	**34.** (1)	**35.** (2)	**36.** (2)	**37.** (4)	**38.** (3)	**39.** (3)	**40.** (3)
41. (2)	**42.** (1)	**43.** (2)	**44.** (1)	**45.** (4)	**46.** (1)	**47.** (3)	**48.** (4)
49. (3)	**50.** (2)	**51.** (44)	**52.** (4)	**53.** (610)	**54.** (1)	**55.** (555)	**56.** (62250)
57. (6)	**58.** (2520)	**59.** (4)	**60.** (3)	**61.** (2)	**62.** (1)	**63.** (1)	**64.** (2)
65. (2)	**66.** (4)	**67.** (1)	**68.** (3)	**69.** (4)	**70.** (1)	**71.** (1)	**72.** (4)
73. (2)	**74.** (1)	**75.** (2)	**76.** (3)	**77.** (3)	**78.** (3)	**79.** (1)	**80.** (1)
81. (2997)	**82.** (8)	**83.** (710)	**84.** (2)	**85.** (9)	**86.** (5)	**87.** (72)	**88.** (36)
89. (180)	**90.** (9)						