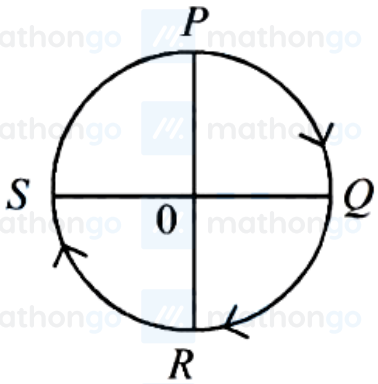
Q1. Applying the principle of homogeneity of dimensions, determine which one is correct, where T is time period, G is gravitational constant, M is mass, r is radius of orbit.

(1) $T^2 = \frac{4\pi^2 r^2}{GM}$ (2) $T^2 = \frac{4\pi^2 r}{GM^2}$

(3) $T^2 = \frac{4\pi^2 r^3}{GM}$ (4) $T^2 = 4\pi^2 r^3$

Q2. A cyclist starts from the point P of a circular ground of radius 2 km and travels along its circumference to the



point S. The displacement of a cyclist is:

(1) $\sqrt{8}$ km (2) 8 km

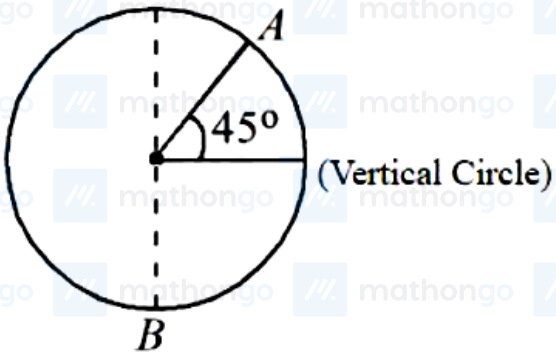
(3) 6 km (4) 4 km

Q3. A 2 kg brick begins to slide over a surface which is inclined at an angle of 45° with respect to horizontal axis. The co-efficient of static friction between their surfaces is:

(1) 1.7 (2) $\frac{1}{\sqrt{3}}$

(3) 0.5 (4) 1

Q4. A body of m kg slides from rest along the curve of vertical circle from point A to B in friction less path. The



velocity of the body at B is:

(given, $R = 14$ m, $g = 10$ m/s^2 and $\sqrt{2} = 1.4$)

(1) 16.7 m/s (2) 19.8 m/s

(3) 10.6 m/s (4) 21.9 m/s

Q5. A 90 kg body placed at 2R distance from surface of earth experiences gravitational pull of :

(R = Radius of earth, g = 10 m s^{-2})

(1) 100 N (2) 300 N

(3) 225 N (4) 120 N

Q6. Correct formula for height of a satellite from earths surface is:

(1) $\left(\frac{T^2R^2}{4\pi^2g}\right)^{1/3} - R$ (2) $\left(\frac{T^2R^2g}{4\pi^2}\right)^{1/3} - R$

(3) $\left(\frac{T^2R^2g}{4\pi^2}\right)^{-1/3} + R$ (4) $\left(\frac{T^2R^2g}{4\pi}\right)^{1/2} - R$

Q7. Given below are two statements : Statement I : The contact angle between a solid and a liquid is a property of the material of the solid and liquid as well. Statement II : The rise of a liquid in a capillary tube does not depend on the inner radius of the tube. In the light of the above statements, choose the correct answer from the options given below:

(1) Statement I is true but Statement II is false. (2) Statement I is false but Statement II is true.

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

Q8. A sample of gas at temperature T is adiabatically expanded to double its volume. Adiabatic constant for the gas is $\gamma = 3/2$. The work done by the gas in the process is: $(\mu = 1 \text{ mole})$

(1) $RT[1 - 2\sqrt{2}]$ (2) $RT[\sqrt{2} - 2]$

(3) $RT[2 - \sqrt{2}]$ (4) $RT[2\sqrt{2} - 1]$

Q9. The translational degrees of freedom (f_t) and rotational degrees of freedom (f_r) of CH_4 molecule are:

(1) $f_t = 2$ and $f_r = 2$ (2) $f_t = 3$ and $f_r = 3$

(3) $f_t = 3$ and $f_r = 2$ (4) $f_t = 2$ and $f_r = 3$

Q10. In simple harmonic motion, the total mechanical energy of given system is E. If mass of oscillating particle P

is doubled then the new energy of the system for same amplitude is:

(1) E (2) $E/\sqrt{2}$

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

Q11. A charge q is placed at the center of one of the surface of a cube. The flux linked with the cube is:

(1) $\frac{q}{2\epsilon_0}$ (2) $\frac{q}{8\epsilon_0}$

(3) Zero (4) $\frac{q}{4\epsilon_0}$

Q12. An electric bulb rated 50 W − 200 V is connected across a 100 V supply. The power dissipation of the bulb is:

(1) 25 W (2) 12.5 W

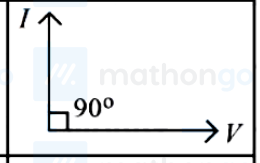
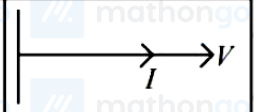
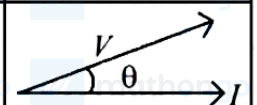
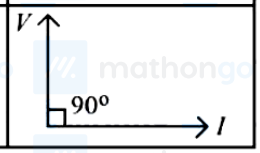
(3) 50 W (4) 100 W

Q13. The magnetic moment of a bar magnet is 0.5Am^2. It is suspended in a uniform magnetic field of 8×10^{-2} T. The work done in rotating it from its most stable to most unstable position is:

(1) 8×10^{-2} J (2) 4×10^{-2} J

(3) Zero (4) 16×10^{-2} J

Q14.

LIST I		LIST II	
A.	Purely capacitive circuit	I.	
B.	Purely inductive circuit	II.	
C.	LCR series at resonance	III.	
D.	LCR series circuit	IV.	

Match List I with List II

Choose the correct answer from the options given below:

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

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

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

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

Q15. Arrange the following in the ascending order of wavelength: A. Gamma rays (λ_1) B. x - rays (λ_2) C. Infrared waves (λ_3) D. Microwaves (λ_4) Choose the most appropriate answer from the options given below

(1) $\lambda_4 < \lambda_3 < \lambda_1 < \lambda_2$

(2) $\lambda_2 < \lambda_1 < \lambda_4 < \lambda_3$

(3) $\lambda_1 < \lambda_2 < \lambda_3 < \lambda_4$

(4) $\lambda_4 < \lambda_3 < \lambda_2 < \lambda_1$

Q16. The width of one of the two slits in a Young's double slit experiment is 4 times that of the other slit. The ratio of the maximum of the minimum intensity in the interference pattern is:

(1) 1 : 1

(2) 4 : 1

(3) 9 : 1

(4) 16 : 1

Q17. Given below are two statements: one is labelled as Assertion **A** and the other is labelled as Reason R. Assertion A: Number of photons increases with increase in frequency of light. Reason R: Maximum kinetic energy of emitted electrons increases with the frequency of incident radiation. In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both **A** and **R** are correct and **R** is the correct explanation of **A**.

(2) Both **A** and **R** are correct and **R** is NOT the correct explanation of **A**.

(3) **A** is not correct but **R** is correct.

(4) **A** is correct but **R** is not correct.

Q18. According to Bohr's theory, the moment of momentum of an electron revolving in 4^{th} orbit of hydrogen atom is:

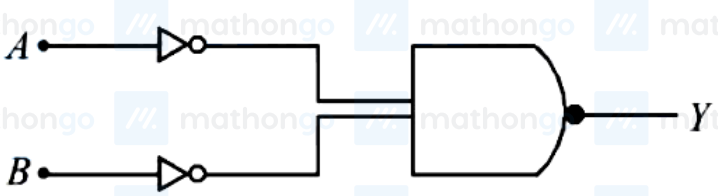
(1) $\frac{h}{\pi}$

(2) $\frac{h}{2\pi}$

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

(4) $2\frac{h}{\pi}$

Q19.



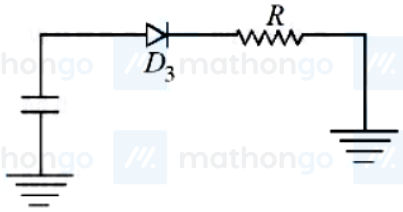
Identify the logic gate given in the circuit:

(1) NAND-gate (2) AND gate

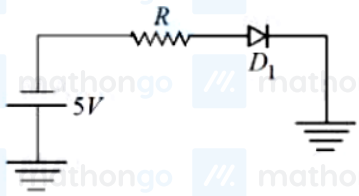
(3) NOR gate (4) OR- gate

Q20. Which of the diode circuit shows correct biasing used for the measurement of dynamic resistance of p-n junction diode :

(1)



(2)



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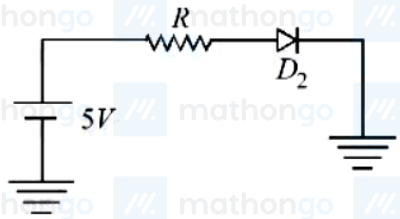

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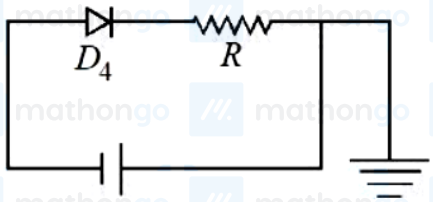


Q21. A bus moving along a straight highway with speed of $72\ \text{km/h}$ is brought to halt within $4s$ after applying the brakes. The distance travelled by the bus during this time (Assume the retardation is uniform) is _____m.

Q22. In a system two particles of masses $m_1 = 3$ kg and $m_2 = 2$ kg are placed at certain distance from each other. The particle of mass m_1 is moved towards the center of mass of the system through a distance 2 cm. In order to keep the center of mass of the system at the original position, the particle of mass m_2 should move towards the center of mass by the distance _____ cm.

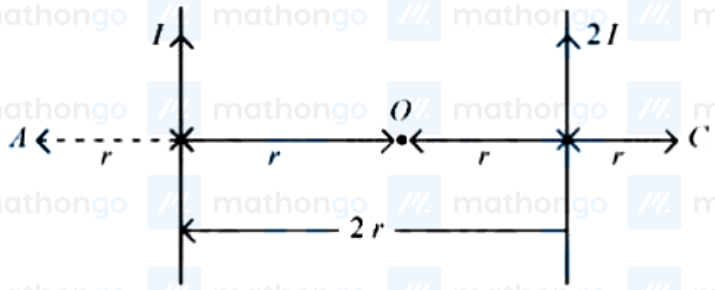
Q23. Mercury is filled in a tube of radius 2 cm up to a height of 30 cm. The force exerted by mercury on the bottom of the tube is _____ N. (Given, atmospheric pressure $= 10^5 \text{Nm}^{-2}$, density of mercury $= 1.36 \times 10^4$ kg m^{-3}, g $= 10$ m s^{-2}, $\pi = \frac{22}{7}$)

Q24. The displacement of a particle executing SHM is given by $x = 10 \sin\left(wt + \frac{\pi}{3}\right)m$. The time period of motion is 3.14 s. The velocity of the particle at $t = 0$ is _____m/s.

Q25. A parallel plate capacitor of capacitance 12.5pF is charged by a battery connected between its plates to potential difference of 12.0 V. The battery is now disconnected and a dielectric slab $(\epsilon_r = 6)$ is inserted between the plates. The change in its potential energy after inserting the dielectric slab is _____ 10^{-12} J.

Q26. Two wires A and B are made up of the same material and have the same mass. Wire A has radius of 2.0 mm and wire B has radius of 4.0 mm. The resistance of wire B is 2Ω. The resistance of wire A is _____Ω.

Q27. Two parallel long current carrying wire separated by a distance $2r$ are shown in the figure. The ratio of magnetic field at A to the magnetic field produced at C is $\frac{x}{7}$. The value of x is _____



Q28. A rod of length 60 cm rotates with a uniform angular velocity 20rads^{-1} about its perpendicular bisector, in a uniform magnetic filed $0.5T$. The direction of magnetic field is parallel to the axis of rotation. The potential difference between the two ends of the rod is _____V.

Q29. A light ray is incident on a glass slab of thickness $4\sqrt{3}$ cm and refractive index $\sqrt{2}$. The angle of incidence is equal to the critical angle for the glass slab with air. The lateral displacement of ray after passing through glass slab is _____ cm. (Given $\sin 15^\circ = 0.25$)

Q30. The disintegration energy Q for the nuclear fission of $^{235}\text{U} \rightarrow {}^{140}\text{Ce} + {}^{94}\text{Zr} + n$ is _____ MeV. Given atomic masses of $^{235}\text{U} : 235.0439u$; $^{140}\text{Ce} : 139.9054u$, $^{94}\text{Zr} : 93.9063u; n : 1.0086u$, Value of $c^2 = 931\text{MeV/u}$

Q31. Choose the Incorrect Statement about Dalton's Atomic Theory

(1) chemical reactions involve reorganization of atoms

(2) Matter consists of indivisible atoms.

(3) Compounds are formed when atoms of different elements combine in any ratio.

(4) Compounds are formed when atoms of different elements combine in any ratio. All the atoms of a given element have identical properties including identical mass.

Q32. The correct order of the first ionization enthalpy is

(1) $\text{Al} > \text{Ga} > \text{Tl}$

(2) $\text{Ga} > \text{Al} > \text{B}$

(3) $\text{Tl} > \text{Ga} > \text{Al}$

(4) $\text{B} > \text{Al} > \text{Ga}$

Q33. Given below are two statements : Statement I : The correct order of first ionization enthalpy values of $\text{Li}, \text{Na}, \text{F}$ and Cl is $\text{Na} < \text{Li} < \text{Cl} < \text{F}$. Statement II : The correct order of negative electron gain enthalpy values of Li, Na, F and Cl is $\text{Na} < \text{Li} < \text{F} < \text{Cl}$ In the light of the above statements, choose the correct answer from the options given below :

(1) Statement I is true but Statement II is false

(2) Statement I is false but Statement II is true

(3) Both Statement I and Statement II are false

(4) Both Statement I and Statement II are true

Q34. The correct statement/s about Hydrogen bonding is/are A. Hydrogen bonding exists when H is covalently bonded to the highly electro negative atom. B. Intermolecular H bonding is present in o-nitro phenol C. Intramolecular H bonding is present in HF. D. The magnitude of H bonding depends on the physical state of

the compound. E. H-bonding has powerful effect on the structure and properties of compounds Choose the correct answer from the options given below:

(1) A, B, D only (2) A, D, E only

(3) A only (4) A, B, C only

Q35. The number of species from the following that have pyramidal geometry around the central atom is _____.

$S_2O_3^{2-}, SO_4^{2-}, SO_3^{2-}, S_2O_7^{2-}$

(1) 4 (2) 3

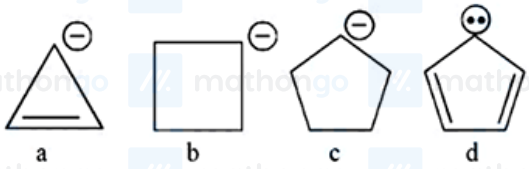
(3) 2 (4) 1

Q36. The equilibrium constant for the reaction $SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$ is $K_c = 4.9 \times 10^{-2}$. The value of K_c for the reaction given below is $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ is :

(1) 4.9 (2) 49

(3) 41.6 (4) 416

Q37.



Correct order of stability of carbanion is -

(1) $d > a > c > b$ (2) a > b > c > d

(3) $d > c > b > a$ (4) $c > b > d >$ a

Q38. Common name of Benzene - 1, 2 - diol is -

(1) catechol (2) o-cresol

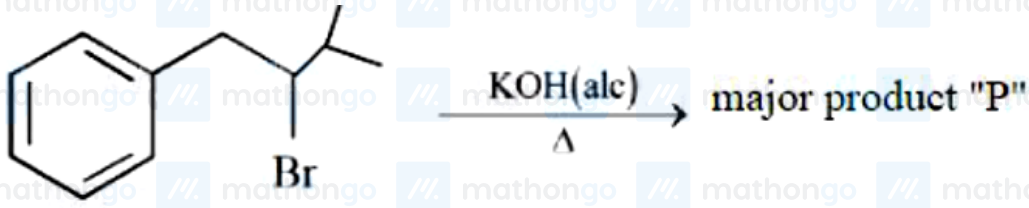
(3) quinol (4) resorcinol

Q39. The adsorbent used in adsorption chromatography is/are - A. silica gel B. alumina C. quick lime D. magnesia Choose the most appropriate answer from the options given below :

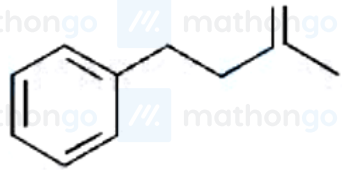
(1) A only (2) B only

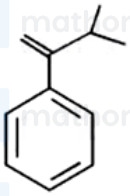
(3) C and D only (4) A and B only

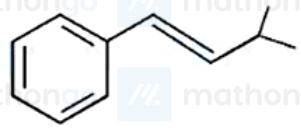
Q40.

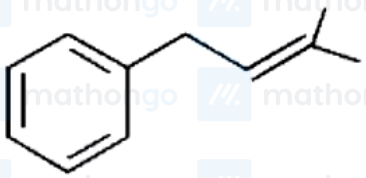


Product P is

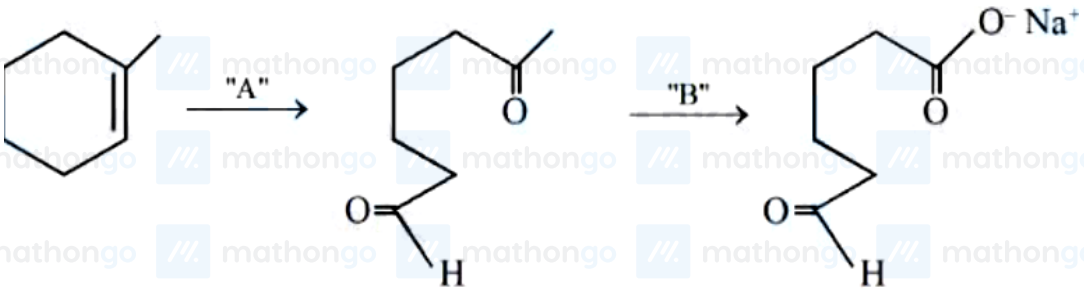
(1) 

(2) 

(3) 

(4) 

Q41.



In the above chemical reaction sequence " A " and " B " respectively are

(1) $H_2O, H^+$and $KMnO_4$ (2) $O_3, Zn/H_2O$ and $NaOH_{(alc)}/I_2$

(3) $O_3, Zn/H_2O$ and $KMnO_4$ (4) $H_2O, H^+$and $NaOH_{(alc)}/I_2$

Q42. For a strong electrolyte, a plot of molar conductivity against (concentration) $^{1/2}$ is a straight line, with a negative slope, the correct unit for the slope is

(1) $Scm^2\ mol^{-3/2}\ L^{-1/2}$ (2) $Scm^2\ mol^{-3/2}\ L^{1/2}$

(3) $Scm^2\ mol^{-3/2}\ L$ (4) $Scm^2\ mol^{-1}\ L^{1/2}$

Q43. Fuel cell, using hydrogen and oxygen as fuels, A. has been used in spaceship B. has as efficiency of 40% to produce electricity C. uses aluminum as catalysts D. is eco-friendry E. is actually a type of Galvanic cell only Choose the correct answer from the options given below:

(1) A, B, D, E only (2) A, D, E only

(3) A, B, D only (4) A, B, C only

Q44. When MnO_2 and H_2SO_4 is added to a salt (A), the greenish yellow gas liberated as salt (A) is :

(1) CaI_2 (2) NaBr

(3) KNO_3 (4) NH_4Cl

Q45. A first row transition metal in its +2 oxidation state has a spin-only magnetic moment value of 3.86BM. The atomic number of the metal is

(1) 26 (2) 25

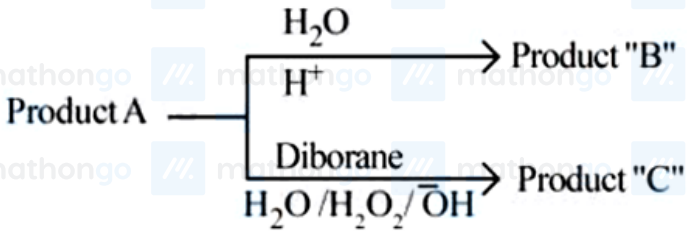
(3) 23 (4) 22

Q46. If an iron (III) complex with the formula $[Fe(NH_3)_x(CN)_y]^-$has no electron in its e_g orbital, then the value of $x + y$ is

(1) 4 (2) 5
(3) 6 (4) 3

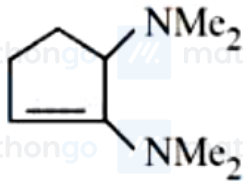
Q47. The number of unpaired d-electrons in $[Co(H_2O)_6]^{3+}$ is
(1) 2 (2) 1
(3) 0 (4) 4

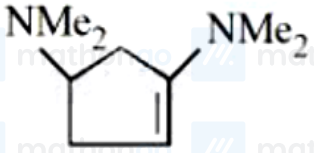
Q48. $CH_3 - CH_2 - CH_2 - Br + NaOH \xrightarrow{C_2H_5OH}$ Product 'A'

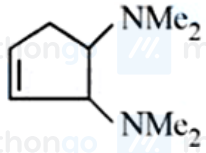


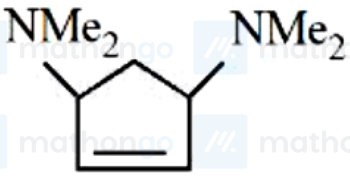
Consider the above reactions, identify product B and product C.
(1) B = 1-Propanol C = 2-Propanol (2) B = C = 2-Propanol
(3) B = 2-Propanol C = 1-Propanol (4) B = C = 1-Propanol

Q49. Find out the major product formed from the following reaction. [Me : $-CH_3$]

(1) 

(2) 

(3) 

(4) 

Q50. Match List I with List II

	List - I		List - II
A.	α - Glucose and α - Galactose	I.	Functional isomers
B.	α - Glucose and β - Glucose	II.	Homologous
C.	α - Glucose and α - Fructose	III.	Anomers
D.	α - Glucose and α - Ribose	IV.	Epimers

Choose the correct answer from the options given below:
(1) A-IV, B-III, C-I, D-II (2) A-III, B-IV, C-I, D-II
(3) A-IV, B-III, C-II, D-I (4) A-III, B-IV, C-II, D-I

Q51. The maximum number of orbitals which can be identified with n = 4 and $m_l = 0$ is _____

Q52. Number of compounds / species from the following with non-zero dipole moment is _____
$BeCl_2, BCl_3, NF_3, XeF_4, CCl_4, H_2O, H_2S, HBr, CO_2, H_2, HCl$

Q53. Three moles of an ideal gas are compressed isothermally from 60 L to 20 L using constant pressure of 5 atm. Heat exchange Q for the compression is - _____ Lit. atm.

Q54. The total number of 'sigma' and 'Pi' bonds in 2-oxohex-4-ynoic acid is _____

Q55. 2.7 kg of each of water and acetic acid are mixed. The freezing point of the solution will be $-x^{\circ}$C. Consider the acetic acid does not dimerise in water, nor dissociates in water. $x =$ _____ (nearest integer) [Given: Molar mass of water $= 18$ g mol^{-1}, acetic acid $= 60$ g mol^{-1} $K_f H_2O$: 1.86 K kg mol^{-1} K_f acetic acid: 3.90 K kg mol^{-1} freezing point: $H_2O = 273$ K, acetic acid $= 290$ K]

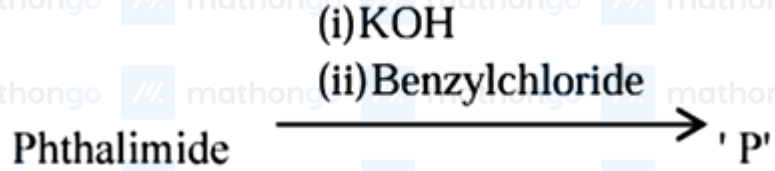
Q56. Consider the following reaction, the rate expression of which is given below

$$A + B \rightarrow C$$
$$\text{rate } = k[A]^{1/2}[B]^{1/2}$$

The reaction is initiated by taking 1M concentration of A and B each. If the rate constant (k) is 4.6×10^{-2} s^{-1}, then the time taken for A to become 0.1M is _____ sec. (nearest integer)

Q57. A first row transition metal with highest enthalpy of atomisation, upon reaction with oxygen at high temperature forms oxides of formula M_2O_n (where $n = 3, 4, 5$). The 'spin-only' magnetic moment value of the amphoteric oxide from the above oxides is _____ BM (near integer) (Given atomic number: Sc : 21, Ti : 22, V : 23, Cr : 24, Mn : 25, Fe : 26, Co : 27, Ni : 28, Cu : 29, Zn : 30)

Q58. Phthalimide is made to undergo following sequence of reactions.



Total number of π bonds present in product 'P' is/are _____

Q59. From 6.55 g of aniline, the maximum amount of acetanilide that can be prepared will be _____ $\times 10^{-1}$ g.

Q60. Vanillin compound obtained from vanilla beans, has total sum of oxygen atoms and π electrons is _____

Q61. The area (in sq. units) of the region $S = \{z \in \mathbb{C} : |z-1| \leq 2; (z+\bar{z}) + i(z-\bar{z}) \leq 2, \text{Im}(z) \geq 0\}$ is

(1) $\frac{7\pi}{3}$ (2) $\frac{7\pi}{4}$
(3) $\frac{17\pi}{8}$ (4) $\frac{3\pi}{2}$

Q62. The value of $\frac{1\times2^2+2\times3^2+\ldots+100\times(101)^2}{1^2\times2+2^2\times3+\ldots+100^2\times101}$ is

(1) $\frac{32}{31}$ (2) $\frac{31}{30}$
(3) $\frac{306}{305}$ (4) $\frac{305}{301}$

Q63. Let three real numbers a, b, c be in arithmetic progression and $a+1, b, c+3$ be in geometric progression. If $a > 10$ and the arithmetic mean of a, b and c is 8, then the cube of the geometric mean of a, b and c is

(1) 128 (2) 316

(3) 120 (4) 312

Q64. If the coefficients of x^4, x^5 and x^6 in the expansion of $(1+x)^n$ are in the arithmetic progression, then the maximum value of n is:

(1) 7 (2) 21

(3) 28 (4) 14

Q65. Let C be a circle with radius $\sqrt{10}$ units and centre at the origin. Let the line $x+y=2$ intersects the circle C at the points P and Q. Let MN be a chord of C of length 2 unit and slope -1. Then, a distance (in units) between the chord PQ and the chord MN is

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

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

Q66. Let PQ be a chord of the parabola $y^2=12x$ and the midpoint of PQ be at $(4,1)$. Then, which of the following point lies on the line passing through the points P and Q?

(1) $(3,-3)$ (2) $(2,-9)$

(3) $\left(\frac{3}{2},-16\right)$ (4) $\left(\frac{1}{2},-20\right)$

Q67. Consider a hyperbola H having centre at the origin and foci on the x-axis. Let C_1 be the circle touching the hyperbola H and having the centre at the origin. Let C_2 be the circle touching the hyperbola H at its vertex and having the centre at one of its foci. If areas (in sq units) of C_1 and C_2 are 36π and 4π, respectively, then the length (in units) of latus rectum of H is

(1) $\frac{14}{3}$ (2) $\frac{28}{3}$

(3) $\frac{11}{3}$ (4) $\frac{10}{3}$

Q68. Let $f(x)=\int_0^x (t+\sin(1-e^t))dt, x \in \mathbb{R}$. Then, $\lim_{x\to 0}\frac{f(x)}{x^3}$ is equal to

(1) $-\frac{1}{6}$ (2) $\frac{2}{3}$

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

Q69. If the mean of the following probability distribution of a random variable X :

X	0	2	4	6	8
P(X)	a	$2a$	$a+b$	$2b$	$3b$

is $\frac{46}{9}$, then the variance of the distribution is

(1) $\frac{173}{27}$ (2) $\frac{566}{81}$

(3) $\frac{151}{27}$ (4) $\frac{581}{81}$

Q70. Let a relation R on $\mathrm{N} \times N$ be defined as: $(x_1, y_1)\mathrm{R}(x_2, y_2)$ if and only if $x_1 \leq x_2$ or $y_1 \leq y_2$. Consider the two statements: (I) R is reflexive but not symmetric. (II) R is transitive Then which one of the following is true?

(1) Both (I) and (II) are correct. (2) Only (II) is correct.

(3) Neither (I) nor (II) is correct. (4) Only (I) is correct.

Q71. Let $A=\begin{bmatrix}1 & 2\\ 0 & 1\end{bmatrix}$ and $B=I+\text{adj}(A)+(\text{adj } A)^2+\ldots+(\text{adj } A)^{10}$. Then, the sum of all the elements of the matrix B is:

(1) -124 (2) 22

(3) -88 (4) -110

Q72. Given that the inverse trigonometric function assumes principal values only. Let x, y be any two real numbers in $[-1,1]$ such that $\cos^{-1}x-\sin^{-1}y=\alpha$, $\frac{-\pi}{2}\le\alpha\le\pi$. Then, the minimum value of $x^2+y^2+2xy\sin\alpha$ is

(1) 0 (2) -1

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

Q73. If the function $f(x)=\begin{cases}\frac{72^x-9^x-8^x+1}{\sqrt{2}-\sqrt{1+\cos x}}, & x\neq 0\\ a\log_e 2\log_e 3 & ,x=0\end{cases}$ is continuous at $x=0$, then the value of a^2 is equal to

(1) 968 (2) 1152

(3) 746 (4) 1250

Q74. Let $f(x)=3\sqrt{x-2}+\sqrt{4-x}$ be a real valued function. If α and β are respectively the minimum and the maximum values of f, then $\alpha^2+2\beta^2$ is equal to

(1) 42 (2) 38

(3) 24 (4) 44

Q75. If the value of the integral $\int_{-1}^{1}\frac{\cos\alpha x}{1+3^x}dx$ is $\frac{2}{\pi}$. Then, a value of α is

(1) $\frac{\pi}{3}$ (2) $\frac{\pi}{6}$

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

Q76. The area (in sq. units) of the region described by $\{(x,y):y^2\le 2x,\text{ and } y\ge 4x-1\}$ is

(1) $\frac{11}{32}$ (2) $\frac{8}{9}$

(3) $\frac{11}{12}$ (4) $\frac{9}{32}$

Q77. Let $y=y(x)$ be the solution of the differential equation $\left(x^2+4\right)^2dy+\left(2x^3y+8xy-2\right)dx=0$. If $y(0)=0$, then $y(2)$ is equal to

(1) $\frac{\pi}{32}$ (2) 2π

(3) $\frac{\pi}{8}$ (4) $\frac{\pi}{16}$

Q78. Let $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=2\hat{i}+4\hat{j}-5\hat{k}$ and $\vec{c}=x\hat{i}+2\hat{j}+3\hat{k}, x\in\mathbb{R}$. If $\vec{d}$ is the unit vector in the direction of $\vec{b}+\vec{c}$ such that $\vec{a}\cdot\vec{d}=1$, then $(\vec{a}\times\vec{b})\cdot\vec{c}$ is equal to

(1) 11 (2) 3

(3) 9 (4) 6

Q79. For $\lambda>0$, let θ be the angle between the vectors $\vec{a}=\hat{i}+\lambda\hat{j}-3\hat{k}$ and $\vec{b}=3\hat{i}-\hat{j}+2\hat{k}$. If the vectors $\vec{a}+\vec{b}$ and $\vec{a}-\vec{b}$ are mutually perpendicular, then the value of $(14\cos\theta)^2$ is equal to

(1) 50 (2) 40

(3) 25 (4) 20

Q80. Let P be the point of intersection of the lines $\frac{x-2}{1}=\frac{y-4}{5}=\frac{z-2}{1}$ and $\frac{x-3}{2}=\frac{y-2}{3}=\frac{z-3}{2}$. Then, the shortest distance of P from the line $4x=2y=z$ is

(1) $\frac{5\sqrt{14}}{7}$ (2) $\frac{3\sqrt{14}}{7}$

(3) $\frac{\sqrt{14}}{7}$ (4) $\frac{6\sqrt{14}}{7}$

Q81. There are 4 men and 5 women in Group A, and 5 men and 4 women in Group B. If 4 persons are selected from each group, then the number of ways of selecting 4 men and 4 women is _____

Q82. Let $S=\left\{\sin^2 2\theta : \left(\sin^4\theta+\cos^4\theta\right)x^2+(\sin 2\theta)x+\left(\sin^6\theta+\cos^6\theta\right)=0 \text{ has real roots }\right\}$. If α and β be the smallest and largest elements of the set S, respectively, then $3\left((\alpha-2)^2+(\beta-1)^2\right)$ equals _____

Q83. Consider a triangle ABC having the vertices $\mathrm{A}(1,2), \mathrm{B}(\alpha,\beta)$ and $\mathrm{C}(\gamma,\delta)$ and angles $\angle ABC=\frac{\pi}{6}$ and $\angle BAC=\frac{2\pi}{3}$. If the points B and C lie on the line $y=x+4$, then $\alpha^2+\gamma^2$ is equal to _____

Q84. Let A be a 2×2 symmetric matrix such that $A\begin{bmatrix}1\\1\end{bmatrix}=\begin{bmatrix}3\\7\end{bmatrix}$ and the determinant of A be 1 . If $A^{-1}=\alpha A+\beta I$, where I is an identity matrix of order 2×2, then $\alpha+\beta$ equals _____

Q85. Consider the function $f:\mathbb{R}\to\mathbb{R}$ defined by $f(x)=\frac{2x}{\sqrt{1+9x^2}}$. If the composition of $\underbrace{f,(f\circ f\circ f\circ\cdots\circ f)}_{10 \text{ times}}(x)=\frac{2^{10}x}{\sqrt{1+9\alpha x^2}}$, then the value of $\sqrt{3\alpha+1}$ is equal to _____

Q86. Let $f:\mathbb{R}\to\mathbb{R}$ be a thrice differentiable function such that $f(0)=0, f(1)=1, f(2)=-1, f(3)=2$ and $f(4)=-2$. Then, the minimum number of zeros of $(3f'f''+ff''')(x)$ is _____

Q87. If $\int \operatorname{cosec}^5 x\,dx=\alpha\cot x\operatorname{cosec}x\left(\operatorname{cossc}^2 x+\frac{3}{2}\right)+\beta\log_\epsilon\left|\tan\frac{x}{2}\right|+C$ where $\alpha,\beta\in\mathbb{R}$ and C is the constant of integration, then the value of $8(\alpha+\beta)$ equals _____

Q88. Let $y=y(x)$ be the solution of the differential equation $(x+y+2)^2dx=dy, y(0)=-2$. Let the maximum and minimum values of the function $y=y(x)$ in $\left[0,\frac{\pi}{3}\right]$ be α and β, respectively. If $(3\alpha+\pi)^2+\beta^2=\gamma+\delta\sqrt{3}, \gamma,\delta\in\mathbb{Z}$, then $\gamma+\delta$ equals _____

Q89. Consider a line L passing through the points $\mathrm{P}(1,2,1)$ and $\mathrm{Q}(2,1,-1)$. If the mirror image of the point $\mathrm{A}(2,2,2)$ in the line L is (α,β,γ), then $\alpha+\beta+6\gamma$ is equal to _____

Q90. In a tournament, a team plays 10 matches with probabilities of winning and losing each match as $\frac{1}{3}$ and $\frac{2}{3}$ respectively. Let x be the number of matches that the team wins, and y be the number of matches that team loses. If the probability $\mathrm{P}(|x-y|\le 2)$ is p, then 3^9p equals _____

ANSWER KEYS

1. (3)	**2.** (1)	**3.** (4)	**4.** (4)	**5.** (1)	**6.** (2)	**7.** (1)	**8.** (3)
9. (2)	**10.** (1)	**11.** (1)	**12.** (2)	**13.** (1)	**14.** (1)	**15.** (3)	**16.** (3)
17. (3)	**18.** (4)	**19.** (4)	**20.** (3)	**21.** (40)	**22.** (3)	**23.** (177)	**24.** (10)
25. (750)	**26.** (32)	**27.** (5)	**28.** (0)	**29.** (2)	**30.** (208)	**31.** (3)	**32.** (3)
33. (4)	**34.** (2)	**35.** (4)	**36.** (4)	**37.** (3)	**38.** (1)	**39.** (4)	**40.** (3)
41. (2)	**42.** (2)	**43.** (2)	**44.** (4)	**45.** (3)	**46.** (3)	**47.** (3)	**48.** (3)
49. (3)	**50.** (1)	**51.** (4)	**52.** (5)	**53.** (200)	**54.** (18)	**55.** (31)	**56.** (50)
57. (0)	**58.** (8)	**59.** (95)	**60.** (11)	**61.** (4)	**62.** (4)	**63.** (3)	**64.** (4)
65. (1)	**66.** (4)	**67.** (2)	**68.** (1)	**69.** (2)	**70.** (4)	**71.** (3)	**72.** (1)
73. (2)	**74.** (1)	**75.** (4)	**76.** (4)	**77.** (1)	**78.** (1)	**79.** (3)	**80.** (2)
81. (5626)	**82.** (4)	**83.** (14)	**84.** (5)	**85.** (1024)	**86.** (5)	**87.** (1)	**88.** (31)
89. (6)	**90.** (8288)						