Q1. Three forces $F_1 = 10\ \text{N},\ F_2 = 8\ \text{N},\ F_3 = 6\ \text{N}$ are acting on a particle of mass $5\ \text{kg}$. The forces F_2 and F_3 are applied perpendicularly so that particle remains at rest. If the force F_1 is removed, then the acceleration of the particle is

(1) $7\ \text{m s}^{-2}$ (2) $0.5\ \text{m s}^{-2}$

(3) $4.8\ \text{m s}^{-2}$ (4) $2\ \text{m s}^{-2}$

Q2. Match List I with List II

	List-I		List-II
A	Spring constant	I	$[T^{-1}]$
B	Angular speed	II	$[MT^{-2}]$
C	Angular momentum	III	$[ML^2]$
D	Moment of Inertia	IV	$[ML^2T^{-1}]$

Choose the correct answer from the options given below:

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

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

Q3. A ball is thrown vertically upward with an initial velocity of $150\ \text{m s}^{-1}$. The ratio of velocity after $3\ \text{s}$ and $5\ \text{s}$ is $\frac{x+1}{x}$. The value of x is _____. {take, $g = 10\ \text{m s}^{-2}$}

(1) 10 (2) -5

(3) 6 (4) 5

Q4. Given below are two statements:

Statement I : A truck and a car moving with same kinetic energy are brought to rest by applying breaks which provide equal retarding forces. Both come to rest in equal distance.

Statement II : A car moving towards east takes a turn and moves towards north, the speed remains unchanged. The acceleration of the car is zero.

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

(1) Statement I is correct but statement II is incorrect (2) Statement I is incorrect but statement II is correct

(3) Both statement I and Statement II are correct (4) Both statement I and statement II are incorrect

Q5. To maintain a speed of $80\ \text{km h}^{-1}$ by a bus of mass $500\ \text{kg}$ on a plane rough road for $4\ \text{km}$ distance, the work done by the engine of the bus will be _____ kJ. [The coefficient of friction between tyre of bus and road is 0.04]

Q6. For rolling spherical shell, the ratio of rotational kinetic energy and total kinetic energy is $\frac{x}{5}$. The value of x is _____.

Q7. Two satellites A and B move round the earth in the same orbit. The mass of A is twice the mass of B. The quantity which is same for the two satellites will be

(1) Speed (2) Kinetic energy

(3) Total energy (4) Potential energy

Q8. The ratio of escape velocity of a planet to the escape velocity of earth will be:-

Given: Mass of the planet is 16 times mass of earth and radius of the planet is 4 times the radius of earth.

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

Q9. 64 identical drops each charged upto potential of 10 mV are combined to form a bigger drop. The potential of the bigger drop will be _____ mV.

Q10. Glycerin of density 1.25×10^3 kg m^{-3} is flowing through the conical section of pipe. The area of cross-section of the pipe at its ends are 10 cm^2 and 5 cm^2 and pressure drop across its length is 3 N m^{-2}. The rate of flow of glycerine through the pipe is $x \times 10^{-5}$ m^3 s^{-1}. The value of x is _____.

Q11. A body cools from 80°C to 60° in 5 minutes. The temperature for the surrounding is 20°C. The time it takes to cool from 60°C to 40°C is

(1) 450 s (2) 420 s
(3) 500 s (4) $\frac{25}{3}$ s

Q12. An engine operating between the boiling and freezing points of water will have

A. Efficiency more than 27%.
B. Efficiency less than the efficiency of a Carnot engine operating between the same two temperatures.
C. Efficiency equal to 27%.
D. Efficiency less than 27%.

Choose the correct answer from the options given below

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

Q13. If the r.m.s speed of chlorine molecule is 490 m s^{-1} at 27°C, the r.m.s speed of argon molecules at the same temperature will be (Atomic mass of argon $= 39.9$ u, molecular mass of chlorine $= 70.9$ u)

(1) 551.7 m s^{-1} (2) 651.7 m s^{-1}
(3) 451.7 m s^{-1} (4) 751.7 m s^{-1}

Q14. A particle is executing simple harmonic motion (SHM). The ratio of potential energy and kinetic energy of the particle when its displacement is half of its amplitude will be

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

Q15. For a certain organ pipe, the first three resonance frequencies are in the ratio of $1 : 3 : 5$ respectively. If the frequency of fifth harmonic is 405 Hz and the speed of sound in air is 324 m s^{-1} the length of the organ pipe is _____ m.

Q16. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A : If an electric dipole of dipole moment 30×10^{-5} C m is enclosed by a closed surface, the net flux coming out of the surface will be zero.

Reason R : Electric dipole consists of two equal and opposite charges.

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

(1) Both A and R are true and R is the correct explanation of A
(2) A is false but R is true
(3) A is true but R is false
(4) Both A and R are true and R is NOT the correct explanation of A

Q17. A wire of resistance 160 Ω is melted and drawn in a wire of one-fourth of its length. The new resistance of the wire will be
(1) 16 Ω
(2) 10 Ω
(3) 640 Ω
(4) 40 Ω

Q18. The current flowing through a conductor connected across a source is 2 A and 1.2 A at 0°C and 100°C respectively. The current flowing through the conductor at 50°C will be _____ $\times 10^2$ mA.

Q19. Given below are two statements:
Statement I : The diamagnetic property depends on temperature.
Statement II : The induced magnetic dipole moment in a diamagnetic sample is always opposite to the magnetising field.
In the light of given statements, choose the correct answer from the options given below
(1) Both Statement I and Statement II are False
(2) Statement I is incorrect but Statement II is true
(3) Statement I is correct but Statement II is false
(4) Both Statement I and Statement II are true

Q20. A compass needle oscillates 20 times per minute at a place where the dip is 30° and 30 times per minute where the dip is 60°. The ratio of total magnetic field due to the earth at two places respectively is $\frac{4}{\sqrt{x}}$. The value of x is

Q21. A conducting circular loop is placed in a uniform magnetic field of 0.4 T with its plane perpendicular to the field. Somehow, the radius of the loop starts expanding at a constant rate of 1 mm s^{-1}. The magnitude of induced emf in the loop at an instant when the radius of the loop is 2 cm will be _____ μV.

Q22. Given below are two statements:
Statement I : When the frequency of an AC source in a series LCR circuit increases, the current in the circuit first increases, attains a maximum value and then decreases.
Statement II : In a series LCR circuit, the value of power factor at resonance is one.
In the light of given statements, choose the most appropriate answer from the options given below.
(1) Statement I is incorrect but Statement II is true
(2) Both Statement I and Statement II are false
(3) Both Statement I and Statement II are true
(4) Statement I is correct but Statement II is false

Q23. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**
Assertion A : EM waves used for optical communication have longer wavelengths than that of microwave, employed in Radar technology.
Reason R : Infrared EM waves are more energetic than microwaves, (used in Radar)
In the light of given statements, choose the correct answer from the options given below.

(1) Both A and R are true but R is NOT the correct explanation of A
(2) A is false but R is true
(3) A is true but R is false
(4) Both A and R are true and R is the correct explanation of A

Q24. An ice cube has a bubble inside. When viewed from one side the apparent distance of the bubble is 12 cm. When viewed from the opposite side, the apparent distance of the bubble is observed as 4 cm. If the side of the ice cube is 24 cm, the refractive index of the ice cube is
(1) $\frac{3}{2}$
(2) $\frac{2}{3}$
(3) $\frac{6}{5}$
(4) $\frac{4}{3}$

Q25. Two convex lenses of focal length 20 cm each are placed coaxially with a separation of 60 cm between them. The image of the distant object formed by the combination is at _____ cm from the first lens.

Q26. A proton and an α-particle are accelerated from rest by 2 V and 4 V potentials, respectively. The ratio of their de-Broglie wavelength is :
(1) 8 : 1
(2) 2 : 1
(3) 4 : 1
(4) 16 : 1

Q27. A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. The number of spectral lines emitted will be:
(1) 1
(2) 4
(3) 2
(4) 3

Q28. A common example of alpha decay is
$^{238}_{92}\mathrm{U} \rightarrow ^{234}_{90}\mathrm{Th} + {}_2\mathrm{He}^4 + Q$
Given:
$^{238}_{92}\mathrm{U} = 238.05060\ \mathrm{u}$
$^{234}_{90}\mathrm{Th} = 234.04360\ \mathrm{u}$
$^4_2\mathrm{He} = 4.00260\ \mathrm{u}$ and $1\mathrm{u} = 931.5\frac{\mathrm{MeV}}{c^2}$
The energy released (Q) during the alpha decay of $^{238}_{92}\mathrm{U}$ is _____ MeV.

Q29. In an n-p-n common emitter (CE) transistor the collector current changes from 5 mA to 16 mA for the change in base current from 100 μA and 200 μA, respectively. The current gain of transistor is _____.
(1) 110
(2) 210
(3) 0.9
(4) 9

Q30. The amplitude of $15\sin(1000\pi t)$ is modulated by $10\sin(4\pi t)$ signal. The amplitude modulated signal contains frequencies 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 and B only (2) A and C only
(3) A and D only (4) A, D and E only

Q31. A metal chloride contains 55.0% of chlorine by weight. 100 mL vapours of the metal chloride at STP weigh 0.57 g. The molecular formula of the metal chloride is
(Given: Atomic mass of chlorine is 35.5 u)
(1) MCl_4 (2) MCl_3
(3) MCl_2 (4) MCl

Q32. Given below are two statement : one is labelled as Assertion A and the other is labelled as Reason R
Assertion A : 5f electron can participate in bonding to a far greater extent than 4f electrons
Reason R : 5f orbitals are not as buried as 4f orbitals
In the light of the above statements, choose the correct answer from the options given below
(1) A is false but R is true (2) Both A and R are true and R is the correct explanation of A
(3) A is true but R is false (4) Both A and R are true but R is NOT the correct explanation of A

Q33. Values of work function (W_0) for a few metals are given below

Metal	Li	Na	K	Mg	Cu	Ag
$\frac{W_0}{eV}$	2.42	2.3	2.25	3.7	4.8	4.3

The number of metals which will show photoelectric effect when light of wavelength 400 nm falls on it is _____
Given: $h = 6.6 \times 10^{-34}$ J s
$c = 3 \times 10^8$ ms^{-1}
$e = 1.6 \times 10^{-19}$ C

Q34. The bond order and magnetic property of acetylide ion are same as that of
(1) O_2^+ (2) N_2^+
(3) NO^+ (4) O_2^-

Q35. Given below are two statements:
Statement I: $SbCl_5$ is more covalent than $SbCl_3$
Statement II: The higher oxides of halogens also tend to be more stable than the lower ones.
In the light of the above statements, choose the most appropriate answer from the options given below.
(1) Statement I is incorrect but statement II is correct (2) Both Statement I and Statement II are incorrect
(3) Both Statement I and Statement II are correct (4) Statement I is correct but statement II is incorrect

Q36. At 600 K, the root mean square (rms) speed of gas X (molar mass = 40) is equal to the most probable speed of gas Y at 90 K. The molar mass of the gas Y is _____ g mol^{-1}. (Nearest integer)

Q37. One mole of an ideal gas at 350 K is in a 2.0 L vessel of thermally conducting walls, which are in contact with the surroundings. It undergoes isothermal reversible expansion from 2.0 L to 3.0 L against a constant pressure of 4 atm. The change in entropy of the surroundings (ΔS) is _____ J K^{-1} (Nearest integer)
Given: $R = 8.314$ J K^{-1} mol^{-1}.

Q38. An analyst wants to convert 1 L HCl of pH = 1 to a solution of HCl of pH = 2. The volume of water needed to do this dilution is _____ mL. (Nearest integer)

Q39. Match List I with List II

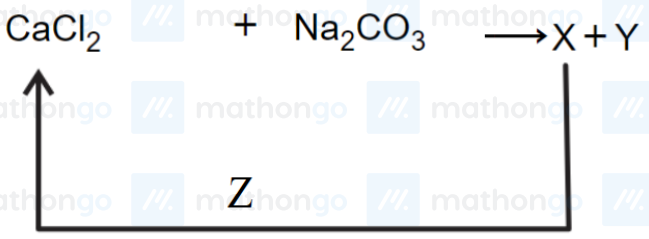
	List I Type of Hydride		List II Example
A	Electron deficient hydride	I	MgH_2
B	Electron rich hydride	II	HF
C	Electron precise hydride	III	B_2H_6
D	Saline hydride	IV	CH_4

Choose the correct answer from the options given below :

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

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

Q40. In the given reaction cycle



X, Y and Z respectively are

(1) $X - CaCO_3,\ Y - NaCl,\ Z - KCl$ (2) $X - CaCO_3,\ Y - NaCl,\ Z - HCl$

(3) $X - CaO,\ Y - NaCl + CO_2,\ Z - NaCl$ (4) $X - CaO,\ Y - NaCl + CO_2,\ Z - KCl$

Q41. The density of alkali metals is in the order

(1) $K < Cs < Na < Rb$ (2) $Na < Rb < K < Cs$

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

Q42. Given below are two statements:

Statement I: Boron is extremely hard indicating its high lattice energy.

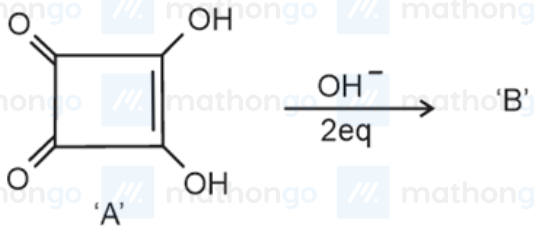
Statement II: Boron has highest melting and boiling point compared to its other group members.

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

(1) Both Statement I and Statement II are incorrect (2) Statement I is correct but Statement II is incorrect

(3) Both statement I and Statement II are correct (4) Statement I is incorrect but Statement II is correct

Q43. Correct statements for the given reaction are:



A. Compound 'B' is aromatic

B. The completion of above reaction is very slow

C. 'A' shows tautomerism

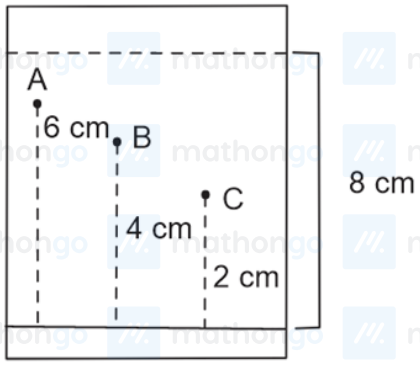
D. The bond lengths of C − C in compound B are found to be same

Choose the correct answer from the options given below.

(1) B, C and D only (2) A, B and C only

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

Q44. Three organic compounds A, B and C were allowed to run in thin layer chromatography using hexane and gave the following result (see figure). The R_f value of the most polar compound is _____ $\times 10^{-2}$



Q45. $2-\text{hexene} \xrightarrow[\text{(ii) } H_2O]{\text{(i) } O_3} \text{Products}$

The two products formed in above reaction are

(1) Butanal and acetaldehyde (2) Butanoic acid and acetaldehyde

(3) Butanal and acetic acid (4) Butanoic acid and acetic acid

Q46. Match List I with List II

List I		List II
A	Nitrogen oxides in air	I Eutrophication
B	Methane in air	II pH of rain water becomes 5.6
C	Carbon dioxide	III Global warming
D	Phosphate fertilisers in water	IV Acid rain

Choose the correct answer from the options given below :

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

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

Q47. 80 mole percent of $MgCl_2$ is dissociated in aqueous solution. The vapour pressure of 1.0 molal aqueous solution of $MgCl_2$ at 38^oC is _____ mm Hg. (Nearest integer)
Given: Vapour pressure of water at 38^oC is 50 mm Hg

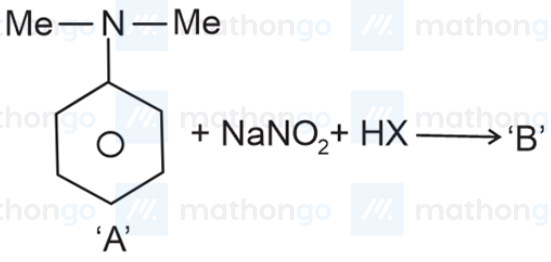
Q48. For lead storage battery pick the correct statements
A. During charging of battery, $PbSO_4$ on anode is converted into PbO_2
B. During charging of battery, $PbSO_4$ on cathode is converted into PbO_2
C. Lead storage battery consists of grid of lead packed with PbO_2 as anode
D. Lead storage battery has ~38% solution of sulphuric acid as an electrolyte
Choose the correct answer from the options given below:
(1) A, B, D only (2) B, C, D only
(3) B, C only (4) B, D only

Q49. The reaction $2NO + Br_2 \rightarrow 2\,NOBr$ takes place through the mechanism given below
$NO + Br_2 \rightleftharpoons NOBr_2$ (fast)
$NOBr_2 + NO \rightarrow 2\,NOBr$ (slow)
The overall order of the reaction is _____.

Q50. Four gases, A, B, C and D have critical temperatures 5.3, 33.2, 126.0 and 154.3K respectively
For their adsorption on a fixed amount of charcoal, the correct order is :
(1) C > D > B > A (2) C > B > D > A
(3) D > C > B > A (4) D > C > A > B

Q51. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R
Assertion A: In the Ellingham diagram, a sharp change in slope of the line is observed from Mg → MgO at ~1120°C
Reason R: There is a large change of entropy associated with the change of state
In the light of the above statements, choose the correct answer from the options given below
(1) Both A and R are true but R is NOT the correct explanation of A (2) A is false but R is true
(3) Both A and R are true and R is the correct explanation of A (4) A is true but R is false

Q52. The incorrect statement regarding the reaction given below is



(1) The product 'B' formed in the above reaction is p-nitroso compound (2) 'B' is N-nitroso ammonium compound
(3) The reaction occurs at low temperature (4) The electrophile involved in the reaction is NO^+

Q53. Match List I with List II

List I Complex		List II $CFSE$ (Δ_0)
A.	$[Cu(NH_3)_6]^{2+}$	I. -0.6
B.	$[Ti(H_2O)_6]^{3+}$	II. -2.0
C.	$[Fe(CN)_6]^{3-}$	III. -1.2
D.	$[NiF_6]^{4-}$	IV. -0.4

Choose the correct answer from the options given below:

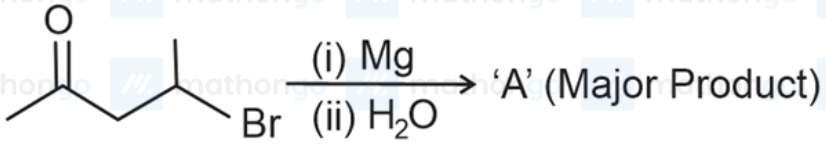
(1) A(III), B(IV), C(I), D(II)

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

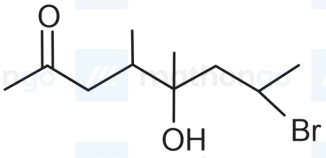
(3) A(I), B(II), C(IV), D(III)

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

Q54. In the following reaction

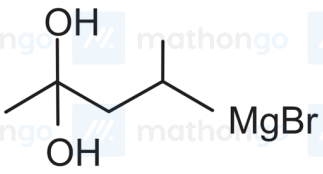


(1)

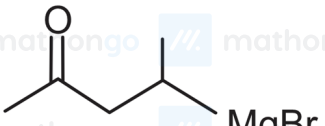


(2)

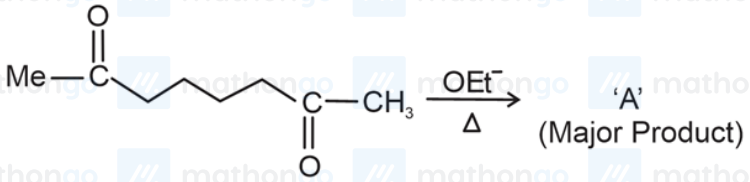
(3)



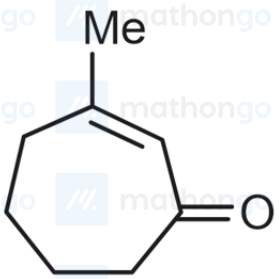
(4)

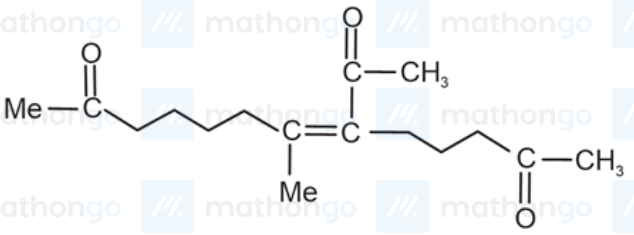


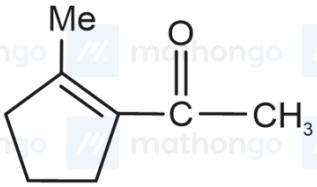
Q55.

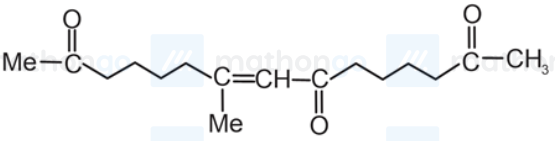


A in the above reaction is :

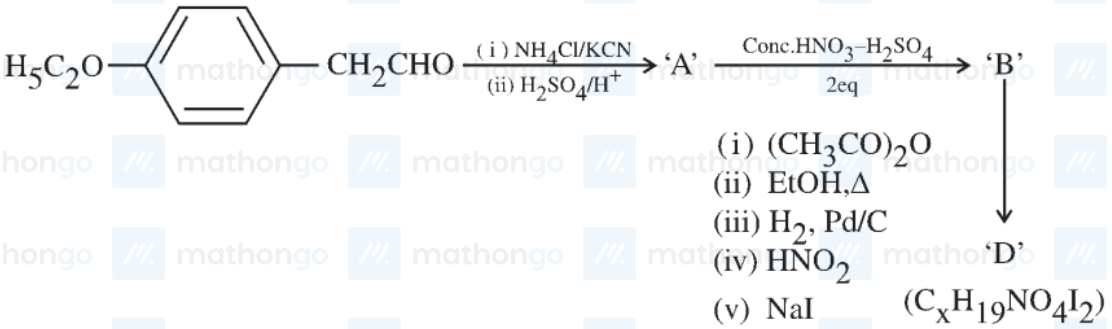
(1) 

(2) 

(3) 

(4) 

Q56.



The value of x in compound 'D' is _____

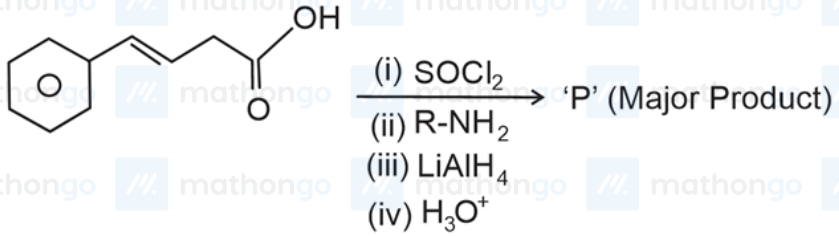
Q57. The mass of NH_3 produced when 131.8 kg of cyclohexane carbaldehyde undergoes Tollen's test is _____ kg. (Nearest Integer)

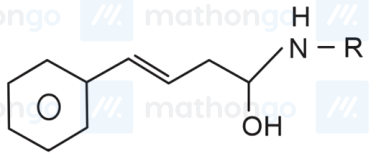
Molar mass of C = 12 g/ mol

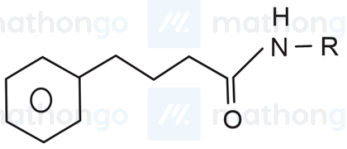
N = 14 g/ mol

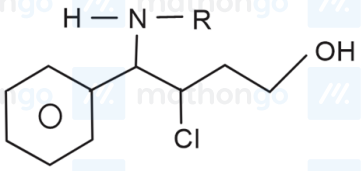
O = 16 g/ mol

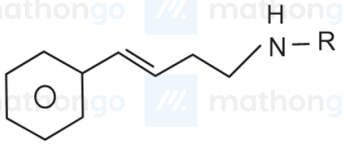
Q58. The major product 'P' formed in the following sequence of reactions is



(1) 

(2) 

(3) 

(4) 

Q59. Match List I with List II

List I (Example)		List II (Type)
A 2-chloro-1, 3-butadiene	I	Biodegradable polymer
B Nylon 2-nylon 6	II	Synthetic Rubber
C Polyacrylonitrile	III	Polyester
D Dacron	IV	Addition Polymer

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

Q60. In an oligopeptide named Alanylglycylphenyl alanyl isoleucine, the number of sp^2 hybridised carbons is _____.

Q61. Let α, β be the roots of the quadratic equation $x^2 + \sqrt{6}x + 3 = 0$. Then $\frac{\alpha^{23}+\beta^{23}+\alpha^{14}+\beta^{14}}{\alpha^{15}+\beta^{15}+\alpha^{10}+\beta^{10}}$ is equal to

(1) 81 (2) 9

(3) 72 (4) 729

Q62. Let C be the circle in the complex plane with centre $z_0 = \frac{1}{2}(1+3i)$ and radius $r = 1$. Let $z_1 = 1+i$ and the complex number z_2 be outside circle C such that $|z_1 - z_0||z_2 - z_0| = 1$. If z_0, z_1 and z_2 are collinear, then the smaller value of $|z_2|^2$ is equal to

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

(3) $\frac{13}{2}$ (4) $\frac{3}{2}$

Q63. The number of five-digit numbers, greater than 40000 and divisible by 5, which can be formed using the digits 0, 1, 3, 5, 7 and 9 without repetition, is equal to

(1) 132 (2) 120

(3) 72 (4) 96

Q64. Let the digits a, b, c be in A.P. Nine-digit numbers are to be formed using each of these three digits thrice such that three consecutive digits are in A.P. at least once. How many such numbers can be formed?

Q65. Let $< a_n >$ be a sequence such that $a_1 + a_2 + \ldots + a_n = \frac{n^2+3n}{(n+1)(n+2)}$. If $28\sum_{k=1}^{10} \frac{1}{a_k} = p_1\, p_2\, p_3 \ldots\, p_m$, where $p_1, p_2, \ldots p_m$ are the first m prime numbers, then m is equal to

(1) 5 (2) 8
(3) 6 (4) 7

Q66. If $\frac{1}{n+1}\,{}^{n}C_{n}+\frac{1}{n}\,{}^{n}C_{n-1}+\ldots+\frac{1}{2}\,{}^{n}C_{1}+{}^{n}C_{0}=\frac{1023}{10}$ then n is equal to
(1) 9 (2) 8
(3) 7 (4) 6

Q67. The sum, of the coefficients of the first 50 terms in the binomial expansion of $(1-x)^{100}$, is equal to
(1) ${}^{101}C_{50}$ (2) ${}^{99}C_{49}$
(3) $-{}^{101}C_{50}$ (4) $-{}^{99}C_{49}$

Q68. If the point $\left(\alpha,\ \frac{7\sqrt{3}}{3}\right)$ lies on the curve traced by the mid-points of the line segments of the lines $x\ \cos\theta+y\sin\theta=7,\ \theta\in\left(0,\ \frac{\pi}{2}\right)$ between the co-ordinates axes, then α is equal to
(1) -7 (2) $-7\sqrt{3}$
(3) $7\sqrt{3}$ (4) 7

Q69. In a triangle ABC, if $\cos A+2\ \cos B+\cos C=2$ and the lengths of the sides opposite to the angles A and C are 3 and 7 respectively, then $\cos\ A-\cos\ C$ is equal to
(1) $\frac{9}{7}$ (2) $\frac{10}{7}$
(3) $\frac{5}{7}$ (4) $\frac{3}{7}$

Q70. Two circles in the first quadrant of radii r_1 and r_2 touch the coordinate axes. Each of them cuts off an intercept of 2 units with the line $x+y=2$. Then ${r_1}^2+{r_2}^2-r_1r_2$ is equal to ____.

Q71. Let $P\left(\frac{2\sqrt{3}}{\sqrt{7}},\ \frac{6}{\sqrt{7}}\right)$, Q, R and S be four points on the ellipse $9x^2+4y^2=36$. Let PQ and RS be mutually perpendicular and pass through the origin. If $\frac{1}{(PQ)^2}+\frac{1}{(RS)^2}=\frac{p}{q}$, where p and q are coprime, then $p+q$ is equal to
(1) 147 (2) 143
(3) 137 (4) 157

Q72. Among the two statements
$(S_1):(p\Rightarrow q)\wedge(p\wedge(\sim q))$ is a contradiction and $(S_2):(p\wedge q)\vee((\sim p)\wedge q)\vee(p\wedge(\sim q))\vee((\sim p)\wedge(\sim q))$ is a tautology
(1) only (S_2) is true (2) only (S_1) is true
(3) both are false (4) both are true

Q73. Let the positive numbers $a_1,\ a_2,\ a_3,\ a_4$ and a_5 be in a G.P. Let their mean and variance be $\frac{31}{10}$ and $\frac{m}{n}$ respectively, where m and n are co-prime. If the mean of their reciprocals is $\frac{31}{10}$ and $a_3+a_4+a_5=14$, then $m+n$ is equal to _____.

Q74. The number of relations, on the set $\{1,\ 2,\ 3\}$ containing $(1,\ 2)$ and $(2,\ 3)$ which are reflexive and transitive but not symmetric, is _____.

Q75. Let $A=\begin{bmatrix}1 & \frac{1}{51}\\ 0 & 1\end{bmatrix}$. If $B=\begin{bmatrix}1 & 2\\ -1 & -1\end{bmatrix}A\begin{bmatrix}-1 & -2\\ 1 & 1\end{bmatrix}$, then the sum of all the elements of the matrix $\sum_{n=1}^{50}B^n$ is equal to

(1) 75 (2) 125
(3) 50 (4) 100

Q76. Let $D_k = \begin{vmatrix} 1 & 2k & 2k-1 \\ n & n^2+n+2 & n^2 \\ n & n^2+n & n^2+n+2 \end{vmatrix}$. If $\sum_{k=1}^{n} D_k = 96$, then n is equal to _____.

Q77. Let D be the domain of the function $f(x) = \sin^{-1}\left(\log_{3x}\left(\frac{6+2\log_3 x}{-5x}\right)\right)$. If the range of the function $g : D \to \mathbb{R}$ defined by $g(x) = x - [x]$, ($[x]$ is the greatest integer function), is (α, β), then $\alpha^2 + \frac{5}{\beta}$ is equal to

(1) 135 (2) 45
(3) 46 (4) 136

Q78. Let $[x]$ be the greatest integer $\le x$. Then the number of points in the interval $(-2, 1)$ where the function $f(x) = |[x]| + \sqrt{x - [x]}$ is discontinuous, is _____.

Q79. If the total maximum value of the function $f(x) = \left(\frac{\sqrt{3e}}{2\sin x}\right)^{\sin^2 x}$, $x \in \left(0, \frac{\pi}{2}\right)$, is $\frac{k}{e}$, then $\left(\frac{k}{e}\right)^8 + \frac{k^8}{e^5} + k^8$ is equal to

(1) $e^3 + e^6 + e^{11}$ (2) $e^5 + e^6 + e^{11}$
(3) $e^3 + e^6 + e^{10}$ (4) $e^3 + e^5 + e^{11}$

Q80. Let $I(x) = \int \sqrt{\frac{x+7}{x}}\,dx$ and $I(9) = 12 + 7\log_e 7$. If $I(1) = \alpha + 7\log_e\left(1 + 2\sqrt{2}\right)$, then α^4 is equal to _____.

Q81. If $\int_{-0.15}^{0.15} |100x^2 - 1|dx = \frac{k}{3000}$, then k is equal to _____.

Q82. The area of the region enclosed by the curve $y = x^3$ and its tangent at the point $(-1, -1)$ is

(1) $\frac{19}{4}$ (2) $\frac{23}{4}$
(3) $\frac{31}{4}$ (4) $\frac{27}{4}$

Q83. Let $y = y(x)$, $y > 0$, be a solution curve of the differential equation $\left(1 + x^2\right)dy = y(x - y)dx$. If $y(0) = 1$ and $y\left(2\sqrt{2}\right) = \beta$, then

(1) $e^{3\beta-1} = e\left(3 + 2\sqrt{2}\right)$ (2) $e^{3\beta-1} = e\left(5 + \sqrt{2}\right)$
(3) $e^{\beta-1} = e^{-2}\left(3 + 2\sqrt{2}\right)$ (4) $e^{\beta-1} = e^{-2}\left(5 + \sqrt{2}\right)$

Q84. Let a, b, c be three distinct real numbers, none equal to one. If the vectors $a\hat{i} + \hat{j} + \hat{k}$, $\hat{i} + b\hat{j} + \hat{k}$ and $\hat{i} + \hat{j} + c\hat{k}$ are coplanar, then $\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c}$ is equal to

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

Q85. Let $\lambda \in \mathbb{Z}$, $\vec{a} = \lambda\hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = 3\hat{i} - \hat{j} + 2\hat{k}$. Let $\vec{c}$ be a vector such that $\left(\vec{a} + \vec{b} + \vec{c}\right) \times \vec{c} = \vec{0}$, $\vec{a} \cdot \vec{c} = -17$ and $\vec{b} \cdot \vec{c} = -20$. Then $\left|\vec{c} \times \left(\lambda\hat{i} + \hat{j} + \hat{k}\right)\right|^2$ is equal to

(1) 46 (2) 53
(3) 62 (4) 49

Q86. Let the plane $x+3y-2z+6=0$ meet the co-ordinate axes at the points $A,\ B,\ C$. If the orthocenter of the triangle ABC is $\left(\alpha,\ \beta,\ \frac{6}{7}\right)$, then $98(\alpha+\beta)^2$ is equal to _____.

Q87. Let the lines $L_1 : \frac{x+5}{3} = \frac{y+4}{1} = \frac{z-\alpha}{-2}$ and $L_2 : 3x+2y+z-2=0=x-3y+2z-13$ be coplanar. If the point $P(a,\ b,\ c)$ on L_1 is nearest to the point $Q(-4,\ -3,\ 2)$, then $|a|+|b|+|c|$ is equal to

(1) 12 (2) 14

(3) 8 (4) 10

Q88. Let the plane $P\ :\ 4x-y+z=10$ be rotated by an angle $\frac{\pi}{2}$ about its line of intersection with the plane $x+y-z=4$. If α is the distance of the point $(2,\ 3,\ -4)$ from the new position of the plane P, then 35α is equal to

(1) 85 (2) 105

(3) 126 (4) 90

Q89. Two dice A and B are rolled. Let the numbers obtained on A and B be α and β respectively. If the variance of $\alpha-\beta$ is $\frac{p}{q}$, where p and q are co-prime, then the sum of the positive divisors of p is equal to

(1) 72 (2) 36

(3) 48 (4) 31

Q90. A fair n $(n>1)$ faces die is rolled repeatedly until a number less than n appears. If the mean of the number of tosses required is $\frac{n}{9}$, then n is equal to

ANSWER KEYS

1. (4)	**2.** (3)	**3.** (4)	**4.** (1)	**5.** (1)	**6.** (4)	**7.** (3)	**8.** (3)
9. (2)	**10.** (2)	**11.** (1)	**12.** (2)	**13.** (2)	**14.** (3)	**15.** (2)	**16.** (1)
17. (3)	**18.** (4)	**19.** (1)	**20.** (4)	**21.** (784)	**22.** (2)	**23.** (160)	**24.** (4)
25. (1)	**26.** (15)	**27.** (243)	**28.** (50)	**29.** (100)	**30.** (4)	**31.** (3)	**32.** (2)
33. (3)	**34.** (3)	**35.** (1)	**36.** (2)	**37.** (4)	**38.** (3)	**39.** (3)	**40.** (4)
41. (3)	**42.** (4)	**43.** (3)	**44.** (3)	**45.** (2)	**46.** (2)	**47.** (2)	**48.** (3)
49. (4)	**50.** (2)	**51.** (3)	**52.** (4)	**53.** (3)	**54.** (9000)	**55.** (25)	**56.** (48)
57. (3)	**58.** (15)	**59.** (60)	**60.** (10)	**61.** (1)	**62.** (1)	**63.** (2)	**64.** (3)
65. (1)	**66.** (4)	**67.** (4)	**68.** (2)	**69.** (4)	**70.** (4)	**71.** (4)	**72.** (1)
73. (1)	**74.** (4)	**75.** (1)	**76.** (4)	**77.** (1)	**78.** (4)	**79.** (3)	**80.** (3)
81. (1260)	**82.** (7)	**83.** (211)	**84.** (4)	**85.** (6)	**86.** (2)	**87.** (64)	**88.** (575)
89. (288)	**90.** (10)						