Q1. Let $\overrightarrow{A_1} = 3$, $\overrightarrow{A_2} = 5$ and $\overrightarrow{A_1} + \overrightarrow{A_2} = 5$. The value of $2\overrightarrow{A_1} + 3\overrightarrow{A_2} \cdot 3\overrightarrow{A_1} - 2\overrightarrow{A_2}$ is:

(1) -112.5
(2) -118.5
(3) -106.5
(4) -99.5

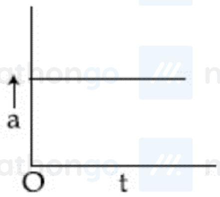
Q2. In a simple pendulum experiment for determination of acceleration due to gravity (g), time taken for 20 oscillations is measures by using a watch of 1 second least count. The mean value of time taken comes out to be 30 s. The length of the pendulum is measured by using a meter scale of least count 1 mm and the value obtained is 55.0 cm. The percentage error in the determination of g is close to

(1) 0.2%
(2) 6.8%
(3) 3.5%
(4) 0.7%

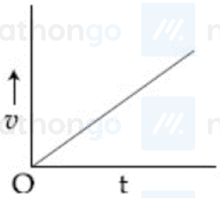
Q3. If Surface tension (S), Moment of Inertia (I) and Planck's constant (h), were to be taken as the fundamental units, the dimensional formula for linear momentum would be:

(1) $S^{1/2}I^{1/2}h^{0}$
(2) $S^{1/2}I^{3/2}h^{-1}$
(3) $S^{3/2}I^{1/2}h^{0}$
(4) $S^{1/2}I^{1/2}h^{-1}$

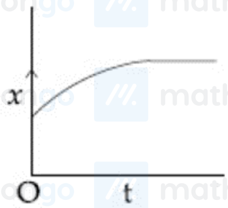
Q4. A particle starts from origin O from rest and moves with a uniform acceleration along the positive x - axis. Identify all figures that correctly represent the motion qualitatively.
(a = acceleration, v = velocity, x = dispalcement, t = time)



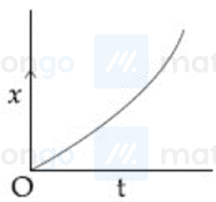
A



B



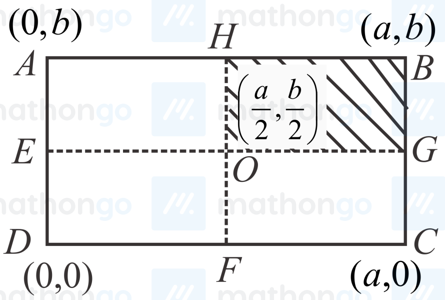
(C)



(D)

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

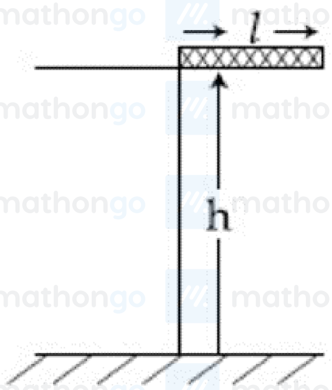
Q5. A uniform rectangular thin sheet $ABCD$ of mass M has length a and breadth b, as shown in the figure. If the shaded portion $HBGO$ is cut-off, the coordinates of the centre of mass of the remaining portion will be:



(1) $\frac{5a}{12}, \frac{5b}{12}$
(2) $\frac{5a}{3}, \frac{5b}{3}$
(3) $\frac{2a}{3}, \frac{2b}{3}$
(4) $\frac{3a}{4}, \frac{3b}{4}$

Q6. A body of mass m_1 moving with an unknown velocity of $v_1\hat{i}$, undergoes a collinear collision with a body of mass m_2 moving with a velocity $v_2\hat{i}$. After the collision, m_1 and m_2 move with velocities of $v_3\hat{i}$ and $v_4\hat{i}$, respectively. If $m_2 = 0.5\,m_1$ and $v_3 = 0.5\,v_1$, then v_1 is:
(1) $v_4 - \frac{v_2}{4}$
(2) $v_4 - \frac{v_2}{2}$
(3) $v_4 + v_2$
(4) $v_4 - v_2$

Q7. A rectangular solid box of length 0.3 m is held horizontally, with one of its sides on the edge of a platform of height 5 m . When released, it slips off the table in a very short time $\tau = 0.01$ s , remaining essentially horizontal. The angle by which it would rotate when it hits the ground will be (in radians) close to:



(1) 0.5
(2) 0.3
(3) 0.02
(4) 0.28

Q8. A solid sphere and solid cylinder of identical radii approach an incline with the same linear velocity (see figure). Both roll without slipping all throughout. The two climb maximum heights h_{sph} and h_{cyl} on the inline. The ratio

$\frac{h_{sph}}{h_{cyl}}$ is given by:

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

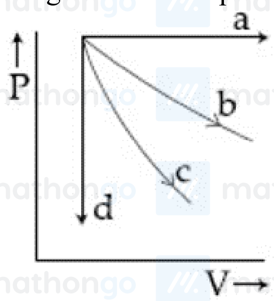
Q9. A rocket has to be launched from earth in such a way that it never returns. If E is the minimum energy delivered by the rocket launcher, what should be the minimum energy that the launcher should have, if the same rocket is to be launched from the surface of the moon? Assume that the density of the earth and the moon are equal and that the earth's volume is 64 times the volume of the moon.

(1) $\frac{E}{64}$
(2) $\frac{E}{4}$
(3) $\frac{E}{32}$
(4) $\frac{E}{16}$

Q10. Young's moduli of two wires A and B are in the ratio $7:4$. Wire A is 2 m long and has radius R. Wire B is 1.5 m long and has radius 2 mm. If the two wires stretch by the same length for a given load, the value of R is close to:

(1) 1.3 mm
(2) 1.9 mm
(3) 1.5 mm
(4) 1.7 mm

Q11. The given diagram shows four processes i.e., isochoric, isobaric, isothermal and adiabatic. The correct assignment of the processes, in the same order is given by:



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

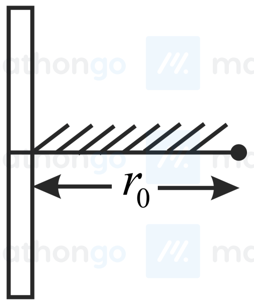
Q12. The temperature, at which the root mean square velocity of hydrogen molecules equals their escape their escape velocity from the earth, is closest to:
[Boltzmann Constant $k_B = 1.38 \times 10^{-23}$ J / K
Avogadro number $N_A = 6.02 \times 10^{26}$ / kg
Radius of Earth: 6.4×10^6 m
Gravitational acceleration on Earth $= 10\ ms^{-2}$]

(1) 3×10^5K
(2) 650 K
(3) 800 K
(4) 10^4 K

Q13. A damped harmonic oscillator has a frequency of 5 oscillations per second. The amplitude drops to half its value for every 10 oscillations. The time it will take to drop to $\frac{1}{1000}$ of the original amplitude is close to:

(1) 50 s
(2) 100 s
(3) 20 s
(4) 10 s

Q14. A positive point charge is released from rest at a distance r_0 from a positive line charge with uniform charge density. The speed (v) of the point charge, as a function of instantaneous distance r from line charge, is proportional to



(1) $v \propto \frac{r}{r_0}$
(2) $v \propto \sqrt{\ln\frac{r}{r_0}}$
(3) $v \propto \ln\frac{r}{r_0}$
(4) $v \propto e^{\frac{+r}{r_0}}$

Q15. An electric dipole is formed by two equal and opposite charges q with separation d . The charges have same mass m. It is kept in a uniform electric field E. If it is slightly rotated from its equilibrium orientation, then its angular frequency ω is:

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

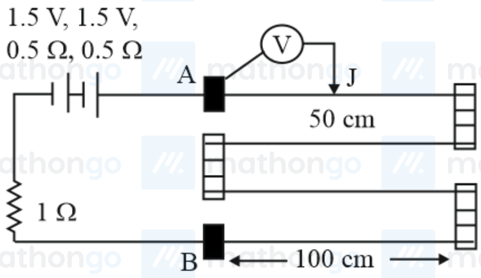
Q16. The electric field in a region is given by $\vec{E} = Ax + B\hat{i}$, where E is in NC^{-1} and x is in metres. The values of constants are A = 20 SI unit and B = 10 SI unit. If the potential at $x = 1$ is V_1 and that at $x = -5$ is V_2, then $V_1 - V_2$ is

(1) 320 V
(2) -520 V
(3) 180 V
(4) -48 V

Q17. A parallel plate capacitor has 1μF capacitance. One of its two plates is given +2μC charge and the other plate, +4 μC charge. The potential difference developed across the capacitor is:

(1) 1 V
(2) 2 V
(3) 3 V
(4) 5 V

Q18. In the circuit shown, a four-wire potentiometer is made of a 400 cm long wire, which extends between A and B . The resistance per unit length of the potentiometer wire is $r = 0.01\ \Omega / cm$. If an ideal voltmeter is connected as shown with jockey J at 50 cm from end A , the expected reading of the voltmeter will be:

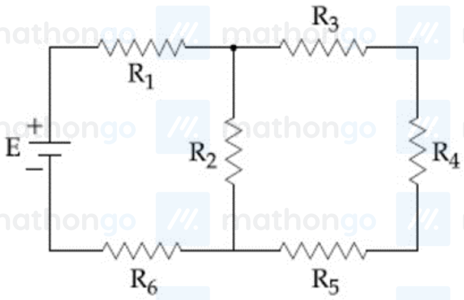


(1) 0.50 V
(2) 0.25 V
(3) 0.75 V
(4) 0.20 V

Q19. A cell of internal resistance r drives current through an external resistance R. The power delivered by the cell to the external resistance will be maximum when:

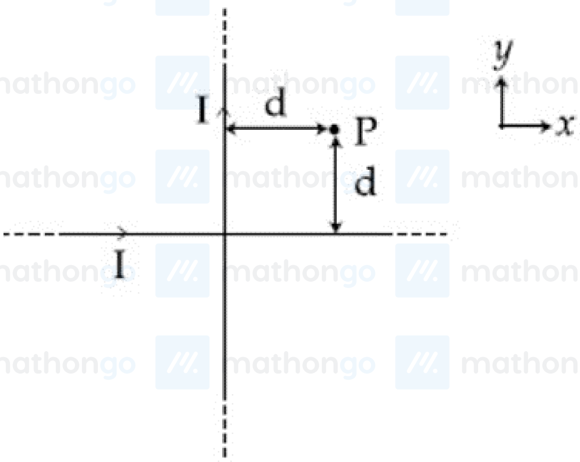
(1) R = 2r
(2) R = r
(3) R = 1000 r
(4) R = 0.001 r

Q20. In the figure shown, what is the current (in Ampere) drawn from the battery? You are given:
$R_1 = 15\ \Omega$, $R_2 = 10\ \Omega$, $R_3 = 20\ \Omega$, $R_4 = 5\ \Omega$, $R_5 = 25\ \Omega$, $R_6 = 30\ \Omega$, $E = 15\ \text{V}$



(1) 9 / 32
(2) 7 / 18
(3) 13 / 24
(4) 20 / 3

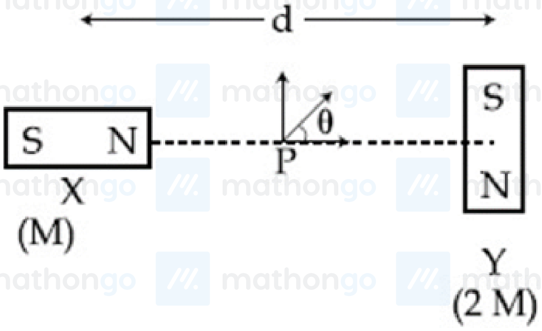
Q21. Two very long, straight, and insulated wires are kept at 90^o angle from each other in xy - plane as shown in figure.



These wires carry currents of equal magnitude I , whose direction are shown in the figure. The net magnetic field at point P will be:

(1) $-\frac{\mu_0 I}{2\pi d}(\hat{x}+\hat{y})$ (2) $\frac{+\mu_0 I}{\pi d}\hat{z}$
(3) $\frac{\mu_0 I}{2\pi d}(\hat{x}+\hat{y})$ (4) Zero

Q22. Two magnetic dipoles X and Y are placed at a separation d , with their axes perpendicular to each other. The dipole moment of Y is twice that of X . A particle of charge q is passing through their mid-point P , at angle $\theta = 45^o$ with the horizontal line, as shown in figure. What would be the magnitude of force on the particle at that instant? (d is much larger than the dimension of the dipole)



(1) 0 (2) $\sqrt{2}\frac{\mu_0}{4\pi}\frac{M}{\left(\frac{d}{2}\right)^3}\times qv$

(3) $\frac{\mu_0}{4\pi}\frac{M}{\left(\frac{d}{2}\right)^3}\times qv$ (4) $\frac{\mu_0}{4\pi}\frac{2M}{\left(\frac{d}{2}\right)^3}\times qv$

Q23. A circuit connected to an ac source of emf $e = e_0 \sin 100t$ with t in seconds, gives a phase difference of $\frac{\pi}{4}$ between the emf e and current i . Which of the following circuits will exhibit this?
(1) RC circuit with R = 1 kΩ and C = 1 μF (2) RL circuit with R = 1 kΩ and L = 1 mH
(3) RL circuit with R = 1 kΩ and L = 10 mH (4) RC circuit with R = 1 kΩ and C = 10 μF

Q24. The magnetic field of an electromagnetic wave is given by:
$\vec{B} = 1.6\times10^{-6}\cos(2\times10^7 z + 6\times10^{15} t)(2\hat{i}+\hat{j})\frac{Wb}{m^2}$
The associated electric field will be:
(1) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z - 6\times10^{15}t)(-2\hat{j}+\hat{i})\frac{V}{m}$ (2) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z + 6\times10^{15}t)(\hat{i}-2\hat{j})\frac{V}{m}$
(3) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z + 6\times10^{15}t)(-\hat{i}+2\hat{j})\frac{V}{m}$ (4) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z - 6\times10^{15}t)(2\hat{i}+\hat{j})\frac{V}{m}$

Q25. Calculate the limit of resolution of a telescope objective having a diameter of 200 cm , if it has to detect light of wavelength 500 nm coming from a star.
(1) 305×10^{-9} radian (2) 610×10^{-9} radian
(3) 152.5×10^{-9} radian (4) 457.5×10^{-9} radian

Q26. A convex lens (of focal length 20 cm) and a concave mirror, having their principal axes along the same lines, are kept 80 cm apart from each other. The concave mirror is to the right of the convex lens. When an object is kept at a distance of 30 cm to the left of the convex lens, its image remains at the same position even if the concave mirror is removed. The maximum distance of the object for which this concave mirror, by itself would produce a virtual image would be:
(1) 30 cm (2) 25 cm
(3) 20 cm (4) 10 cm

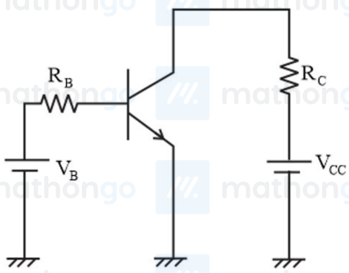
Q27. A nucleus A, with a finite de-broglie wavelength λ_A, undergoes spontaneous fission into two nuclei B and C of equal mass. B flies in the same direction as that of A, while C flies in the opposite direction with a velocity equal to half of that of B. The de-Broglie wavelengths λ_B and λ_C of B and C are respectively:

(1) $\lambda_A, \frac{\lambda_A}{2}$
(2) $\frac{\lambda_A}{2}, \lambda_A$
(3) $\lambda_A, 2\lambda_A$
(4) $2\lambda_A, \lambda_A$

Q28. The ratio of mass densities of nuclei of ^{40}Ca and ^{16}O is close to:

(1) 1
(2) 0.1
(3) 2
(4) 5

Q29. A common emitter amplifier circuit, built using an NPN transistor, is shown in the figure. Its dc current gain is 250, $R_C = 1\ k\Omega$ and $V_{CC} = 10\ V$. The minimum base current for V_{CE} to reach saturation is



(1) 10 μA
(2) 40 μA
(3) 7 μA
(4) 100 μA

Q30. In a line of sight radio communication, a distance of about 50 km is kept between the transmitting and receiving antennas. If the height of the receiving antenna is 70 m, then the minimum height of the transmitting antenna should be: (Radius of the Earth $= 6.4 \times 10^6$ m)

(1) 20 m
(2) 51 m
(3) 40 m
(4) 32 m

Q31. The percentage composition of carbon by mole in methane is:

(1) 75 %
(2) 20 %
(3) 80 %
(4) 25 %

Q32. 0.27 g of a long chain fatty acid was dissolved in 100 cm^3 of hexane. 10 mL of this solution was added dropwise to the surface of water in a round watch glass. Hexane evaporates and a monolayer is formed. The distance from edge to centre of the watch glass is 10 cm. What is the height of the monolayer?
[Density of fatty acid $= 0.9\ g\ cm^{-3}$; $\pi = 3$]

(1) 10^{-4} m
(2) 10^{-6} m
(3) 10^{-8} m
(4) 10^{-2} m

Q33. If p is the momentum of the fastest electron ejected from a metal surface after the irradiation of light having wavelength λ, then for 1.5 p momentum of the photoelectron, the wavelength of the light should be:
(Assume kinetic energy of ejected photoelectron to be very high in comparison to work function)

(1) $\frac{4}{9}\lambda$
(2) $\frac{3}{4}\lambda$
(3) $\frac{2}{3}\lambda$
(4) $\frac{1}{2}\lambda$

Q34. The IUPAC symbol for the element with atomic number 119 would be:
(1) Unh
(2) Uun
(3) Une
(4) Uue

Q35. Among the following molecules/ ions,
C_2^{2-}, N_2^{2-}, O_2^{2-}, O_2
Which one is diamagnetic and has the shortest bond length?
(1) N_2^{2-}
(2) O_2^{2-}
(3) O_2
(4) C_2^{2-}

Q36. 5 moles of an ideal gas at 100 K are allowed to undergo reversible compression till its temperature becomes 200 K. If $C_V = 28\ J\ K^{-1}$, calculate ΔU and ΔpV for the process. $\left(R = 8.0\ J\ K^{-1}\ mol^{-1}\right)$
(1) $\Delta U = 14\ J;\ \Delta pV = 0.8\ J$
(2) $\Delta U = 14\ kJ;\ \Delta pV = 18\ kJ$
(3) $\Delta U = 14\ kJ;\ \Delta pV = 4\ kJ$
(4) $\Delta U = 2.8\ kJ;\ \Delta pV = 0.8\ kJ$

Q37. For the following reaction, equilibrium constant are given:
$Ss + O_2g \rightleftharpoons SO_2g; \quad K_1 = 10^{52}$
$2Ss + 3O_2g \rightleftharpoons 2SO_3g; \quad K_2 = 10^{129}$
The equilibrium constant for the reaction, $2SO_2g + O_2g \rightleftharpoons 2SO_3g$ is:
(1) 10^{154}
(2) 10^{25}
(3) 10^{181}
(4) 10^{77}

Q38. The strength of 11.2 volume solution of H_2O_2 is
[Given that, the molar mass of $H = 1\ \ g\ mol^{-1}$ and $O = 16\ g\ mol^{-1}$]
(1) 1.7 %
(2) 13.6 %
(3) 34 %
(4) 3.4 %

Q39. The covalent alkaline earth metal halide $X = Cl, Br, I$ is:
(1) CaX_2
(2) MgX_2
(3) SrX_2
(4) BeX_2

Q40. Which of the following compounds will show the maximum 'enol' content?
(1) $CH_3COCH_2CONH_2$
(2) $CH_3COCH_2COCH_3$
(3) $CH_3COCH_2COOC_2H_5$
(4) CH_3COCH_3

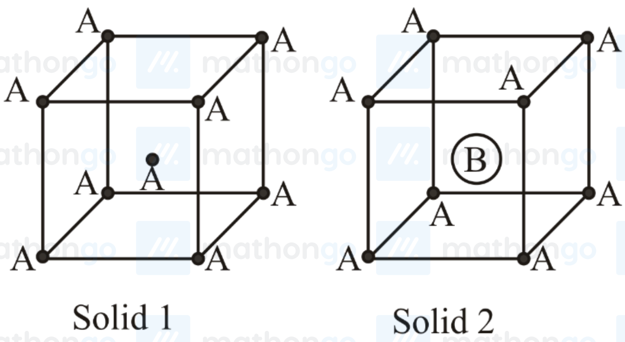
Q41. Polysubstitution is a major drawback in:
(1) Reimer Tiemann reaction
(2) Friedel Craft's alkylation
(3) Acetylation of aniline
(4) Friedel Craft's acylation

Q42. Which one of the following alkenes when treated with HCl yields majorly an anti Markovnikov product?
(1) $CH_3O - CH = CH_2$
(2) $Cl - CH = CH_2$
(3) $H_2N - CH = CH_2$
(4) $F_3C - CH = CH_2$

Q43. The maximum prescribed concentration of copper in drinking water is:

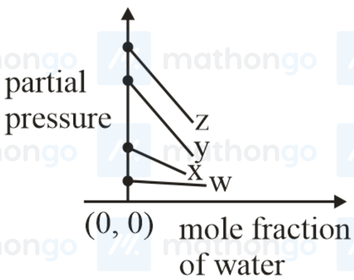
(1) 3 ppm
(2) 5 ppm
(3) 0.5 ppm
(4) 0.05 ppm

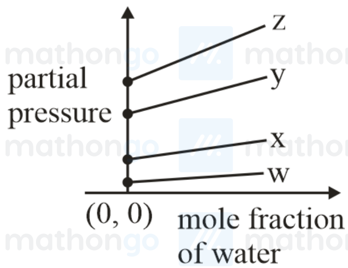
Q44. Consider the bcc unit cells of the solids 1 and 2 with the position of atoms as shown below. The radius of atom B is twice that of atom A. The unit cell edge length is 50 % more in solid 2 than in 1 . What is the approximate packing efficiency in solid 2 ?

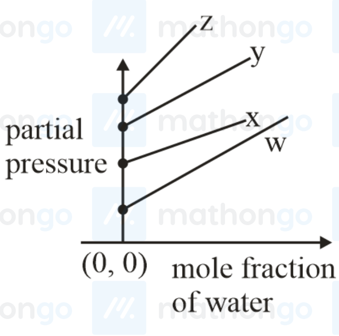


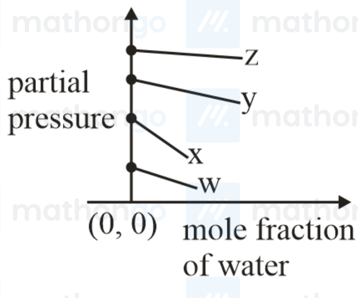
(1) 90 %
(2) 45 %
(3) 75 %
(4) 65 %

Q45. For the solution of the gases w, x, y and z in water at 298 K, the Henry's law constants (K_H) are 0.5, 2, 35 and 40 kbar, respectively. The correct plot for the given data is:

(1)


(2)


(3)


(4)


Q46. Calculate the standard cell potential (in V) of the cell in which the following reaction takes place:

$Fe^{2+}\ aq + Ag^{+} aq \rightarrow Fe^{3+}\ aq + Ag(s)$

Given that

$E^{o}_{Ag^{+}/Ag} = x\ V$

$E^{o}_{Fe^{2+}/Fe} = y\ V$

$E^{o}_{Fe^{3+}/Fe} = z\ V$

(1) $x + 2y - 3z$
(2) $x - y$
(3) $x - z$
(4) $x + y - z$

Q47. For a reaction scheme $A \xrightarrow{k_1} B \xrightarrow{k_2} C$, if the net rate of formation of B is set to be zero then the concentration of B is given by:

(1) $k_1 + k_2 [A]$
(2) $k_1 k_2 [A]$
(3) $\frac{k_1}{k_2} [A]$
(4) $k_1 - k_2 [A]$

Q48. The Mond process is used for the:

(1) Purification of Zr and Ti
(2) Purification of Ni
(3) Extraction of Zn
(4) Extraction of Mo

Q49. The ion that has sp^3d^2 hybridization for the central atom is:

(1) BrF_2^-
(2) ICl_4^-
(3) IF_6^-
(4) ICl_2^-

Q50. The correct statement about ICl_5 and ICl_4^- is:

(1) ICl_5 is trigonal bipyramidal and ICl_4^- is tetrahedral.
(2) Both are isostructural.
(3) ICl_5 is square pyramidal and ICl_4^- is tetrahedral.
(4) ICl_5 is square pyramidal and ICl_4^- is square planar.

Q51. The statement that is INCORRECT about the interstitial compounds is:

(1) They have high melting points.
(2) They are very hard.
(3) They are chemically reactive.
(4) They have metallic conductivity.

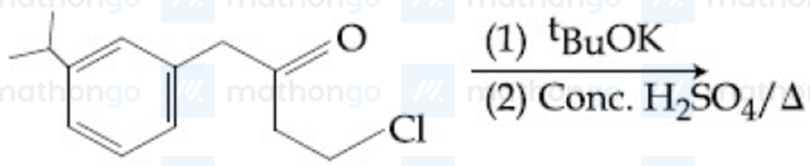
Q52. The compound that inhibits the growth of tumors is:

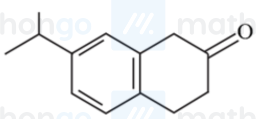
(1) trans - $PtCl_2NH_{3_2}$
(2) cis - $PtCl_2NH_{3_2}$
(3) cis - $PdCl_2NH_{3_2}$
(4) trans - $PdCl_2NH_{3_2}$

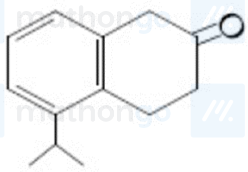
Q53. The calculated spin-only magnetic moments BM of the anionic and cationic species of $FeH_2O_6^{+2}$ and $Fe\,CN_6^{4-}$ respectively, are:

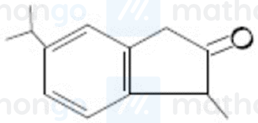
(1) 0 and 4.9
(2) 2.84 and 5.92
(3) 4.9 and 0
(4) 0 and 5.92

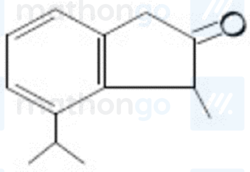
Q54. The major product of the following reaction is:



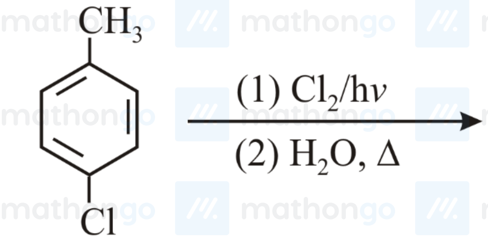
(1) 

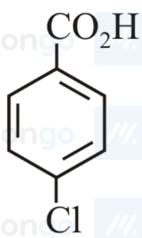
(2) 

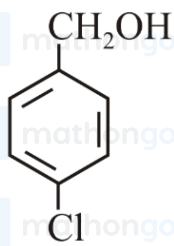
(3) 

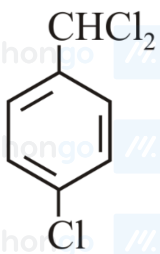
(4) 

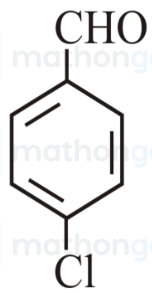
Q55. The major product of the following reaction is:



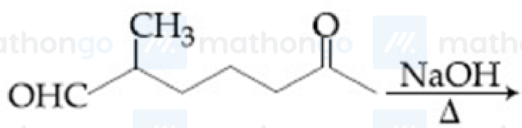
(1) 

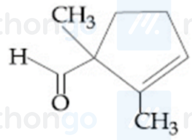
(2) 

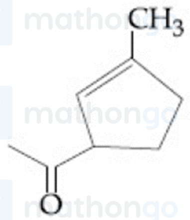
(3) 

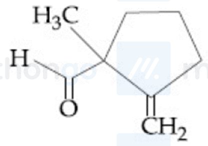
(4) 

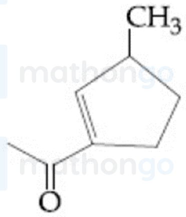
Q56. The major product obtained in the following reaction is:



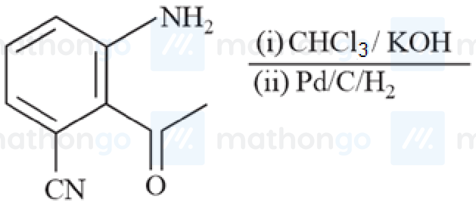
(1) 

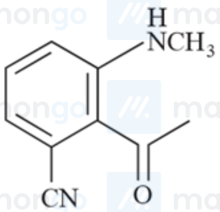
(2) 

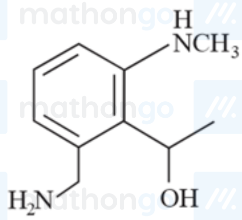
(3) 

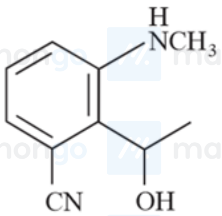
(4) 

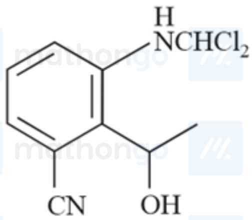
Q57. The major product obtained in the following reaction is:



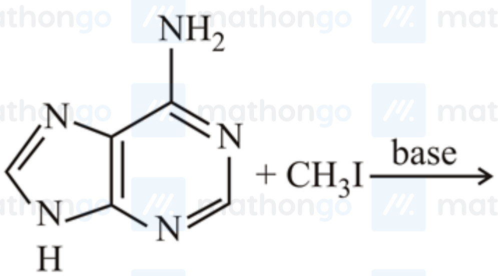
(1) 

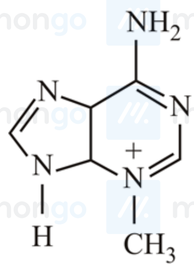
(2) 

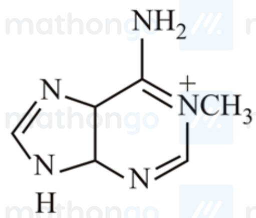
(3) 

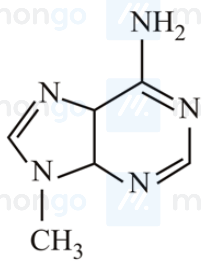
(4) 

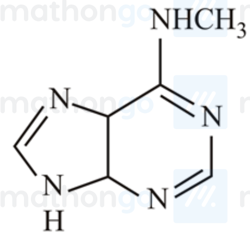
Q58. The major product in the following reaction is:



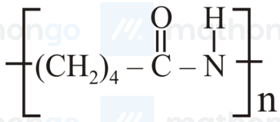
(1)


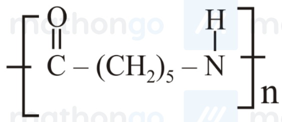
(2)


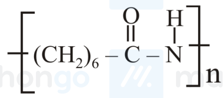
(3)


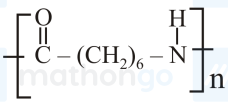
(4)


Q59. The structure of Nylon - 6 is:

(1)


(2)


(3)


(4)


Q60. Fructose and glucose can be distinguished by:

(1) Fehling's test
(2) Benedict's test
(3) Barfoed's test
(4) Seliwanoff's test

Q61. If three distinct numbers a, b, c are in G.P. and the equations $ax^2 + 2bx + c = 0$ and $dx^2 + 2ex + f = 0$ have a common root, then which one of the following statements is correct?

(1) $\frac{d}{a}, \frac{e}{b}, \frac{f}{c}$ are in A.P.
(2) d, e, f are in A.P.
(3) d, e, f are in G.P.
(4) $\frac{d}{a}, \frac{e}{b}, \frac{f}{c}$ are in G.P.

Q62. The number of integral values of m for which the equation, $1 + m^2 x^2$ - $21 + 3mx + 1 + 8m = 0$ has no real root, is

(1) 2
(2) 3
(3) Infinitely many
(4) 1

Q63. If $z = \frac{\sqrt{3}}{2} + \frac{i}{2}\, i = \sqrt{-1}$, then $1 + iz + z^5 + iz^{8^9}$ is equal to:

(1) -1
(2) 1
(3) 0
(4) $-1 + 2i^9$

Q64. The number of four-digit numbers strictly greater than 4321 that can be formed using the digit 0,1, 2,3, 4,5 (repetition of digits is allowed) is:

(1) 360
(2) 288
(3) 306
(4) 310

Q65. The sum $\sum_{k=1}^{20} k\frac{1}{2^k}$ is equal to

(1) $1 - \frac{11}{2^{20}}$
(2) $2 - \frac{21}{2^{20}}$
(3) $2 - \frac{3}{2^{17}}$
(4) $2 - \frac{11}{2^{19}}$

Q66. If the fourth term in the binomial expansion of $\left(\sqrt{x^{\frac{1}{1+\log_{10}x}}} + x^{\frac{1}{12}}\right)^6$ is equal to 200, and $x > 1$, then the value of x is

(1) 100
(2) 10^4
(3) 10^3
(4) 10

Q67. Suppose that the points (h, k), $(1, 2)$ and $(-3, 4)$ lie on the line L_1. If a line L_2 passing through the points (h, k) and $(4, 3)$ is perpendicular to L_1, then $\frac{k}{h}$ equals:

(1) $-\frac{1}{7}$
(2) 3
(3) 0
(4) $\frac{1}{3}$

Q68. The tangent and the normal lines at the point $(\sqrt{3}, 1)$ to the circle $x^2 + y^2 = 4$ and the x-axis form a triangle. The area of this triangle (in square units) is:

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

Q69. The tangent to the parabola $y^2 = 4x$ at the point where it intersects the circle $x^2 + y^2 = 5$ in the first quadrant, passes through the point:

(1) $\left(\frac{1}{4}, \frac{3}{4}\right)$
(2) $\left(-\frac{1}{3}, \frac{4}{3}\right)$
(3) $\left(-\frac{1}{4}, \frac{1}{2}\right)$
(4) $\left(\frac{3}{4}, \frac{7}{4}\right)$

Q70. In an ellipse, with centre at the origin, if the difference of the lengths of major axis and minor axis is 10 and one of the foci is at $(0, 5\sqrt{3})$, then the length of its latus rectum is:

(1) 6
(2) 10
(3) 8
(4) 5

Q71. If the eccentricity of the standard hyperbola passing through the point $(4,6)$ is 2, then the equation of the tangent to the hyperbola at $(4,6)$ is:

(1) $2x - 3y + 10 = 0$
(2) $x - 2y + 8 = 0$
(3) $3x - 2y = 0$
(4) $2x - y - 2 = 0$

Q72. Let $f: R \to R$ be a differentiable function satisfying $f'(3) + f'(2) = 0$. Then $\lim_{x \to 0}\left(\frac{1 + f(3 + x) - f(3)}{1 + f(2 - x) - f(2)}\right)^{\frac{1}{x}}$ is equal to

(1) 1
(2) e
(3) e^2
(4) e^{-1}

Q73. Which one of the following statements is not a tautology?

(1) $(p \vee q) \to (p \vee (\sim q))$
(2) $(p \wedge q) \to (\sim p) \vee q$
(3) $p \to (p \vee q)$
(4) $(p \wedge q) \to p$

Q74. A student scores the following marks in five tests: $45,54,41,57,43$. His score is not known for the sixth test. If the mean score is 48 in the six tests, then the standard deviation of the marks in six tests is:

(1) $\frac{10}{3}$ (2) $\frac{100}{3}$
(3) $\frac{10}{\sqrt{3}}$ (4) $\frac{100}{\sqrt{3}}$

Q75. Two vertical poles of height, $20\ m$ and $80\ m$ stand apart on a horizontal plane. The height (in meters) of the point of intersection of the lines joining the top of each pole to the foot of the other, from this horizontal plane is:

(1) 16 (2) 12
(3) 18 (4) 15

Q76. If the lengths of the sides of a triangle are in A.P and the greatest angle is double the smallest, then a ratio of lengths of the sides of this triangle is:

(1) $3:4:5$ (2) $5:6:7$
(3) $5:9:13$ (4) $4:5:6$

Q77. Let the numbers $2,\ b,\ c$ be in an A.P. and $A = \begin{matrix} 1 & 1 & 1 \\ 2 & b & c \\ 4 & b^2 & c^2 \end{matrix}$. If $\det(A) \in [2,16]$, then c lies in the interval:

(1) $2,3$ (2) $4,6$
(3) $3,2+2^{\frac{3}{4}}$ (4) $2+2^{\frac{3}{4}},4$

Q78. If the system of linear equations

$x - 2y + kz = 1$
$2x + y + z = 2$
$3x - y - kz = 3$

has a solution $x,y,z,z \neq 0$, then x,y lies on the straight line whose equation is:

(1) $4x - 3y - 4 = 0$ (2) $3x - 4y - 4 = 0$
(3) $3x - 4y - 1 = 0$ (4) $4x - 3y - 1 = 0$

Q79. Let $fx = \mathrm{a}^x\ (\mathrm{a} > 0)$ be written as $fx = f_1x + f_2x$, where $f_1(x)$ is an even function and $f_2(x)$ is an odd function. Then $f_1x + y + f_1(x - y)$ equals:

(1) $2f_1xf_1y$ (2) $2f_1x + yf_1x - y$
(3) $2f_1xf_2y$ (4) $2f_1x + yf_2x - y$

Q80. Let $f: -1,3 \rightarrow \mathrm{R}$ be defined as

$$fx = \begin{matrix} x + x, & -1 \leq x < 1 \\ x + x, & 1 \leq x < 2 \\ x + x, & 2 \leq x \leq 3, \end{matrix}$$

Where t denotes the greatest integer less than or equal to t. Then, f is discontinuous at:

(1) Only one point (2) Only two points
(3) Four or more points (4) Only three points

Q81. If $f1 = 1, f^{'}1 = 3$, then the derivative of $fffx + fx^2$ at $x = 1$ is:

(1) 9
(2) 12
(3) 15
(4) 33

Q82. The height of a right circular cylinder of maximum volume inscribed in a sphere of radius 3 is:

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

Q83. Given that the slope of the tangent to a curve $y = y(x)$ at any point x, y is $\frac{2y}{x^2}$. If the curve passes through the centre of the circle $x^2 + y^2 - 2x - 2y = 0$, then its equation is

(1) $x^2 \log_e |y| = -2(x-1)$
(2) $x \log_e |y| = 2(x-1)$
(3) $x \log_e |y| = -2(x-1)$
(4) $x \log_e |y| = x - 1$

Q84. If $\int \frac{dx}{x^3 1 + x^{6 \frac{2}{3}}} = x f x 1 + x^{6 \frac{1}{3}} + C$, where C is a constant of integration, then the function $f x$ is equal to

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

Q85. Let $f x = \int_0^x g t dt$, where g is a non-zero even function. If $f x + 5 = g x$, then $\int_0^x f(t) dt$ equals

(1) $\int_5^{x+5} g(t) dt$
(2) $\int_{x+5}^{5} g(t) dt$
(3) $5 \int_{x+5}^{5} g(t) dt$
(4) $2 \int_5^{x+5} g(t) dt$

Q86. Let $S\alpha = x, y : y^2 \leq x,\ 0 \leq x \leq \alpha$ and $A\alpha$ is area of the region $S\alpha$. If for a $\lambda, 0 < \lambda < 4$, $A\lambda : A4 = 2:5$, then λ equals:

(1) $4 \frac{2}{5}^{\frac{1}{3}}$
(2) $2 \frac{4}{25}^{\frac{1}{3}}$
(3) $4 \frac{4}{25}^{\frac{1}{3}}$
(4) $2 \frac{2}{5}^{\frac{1}{3}}$

Q87. Let $\vec{a} = 3\hat{i} + 2\hat{j} + x\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$, for some real x. Then the condition for $\vec{a} \times \vec{b} = r$ to follow

(1) $0 < r \leq \sqrt{\frac{3}{2}}$
(2) $r \geq 5\sqrt{\frac{3}{2}}$
(3) $\sqrt{\frac{3}{2}} < r \leq 3\sqrt{\frac{3}{2}}$
(4) $3\sqrt{\frac{3}{2}} < \mathrm{r} < 5\sqrt{\frac{3}{2}}$

Q88. The vector equation of the plane through the line of intersection of the planes $x + y + z = 1$ and $2x + 3y + 4z = 5$ which is perpendicular to the plane $x - y + z = 0$ is

(1) $\vec{r} \times \hat{i} + \hat{k} + 2 = 0$
(2) $\vec{r} \cdot \hat{i} - \hat{k} - 2 = 0$
(3) $\vec{r} \times \hat{i} - \hat{k} + 2 = 0$
(4) $\vec{r} \cdot (\hat{i} - \hat{k}) + 2 = 0$

Q89. If a point $R 4, y, z$ lies on the line segment joining the points $P 2, -3, 4$ and $Q 8, 0, 10$, then the distance of R from the origin is

(1) $2\sqrt{21}$
(2) $\sqrt{53}$
(3) 6
(4) $2\sqrt{14}$

Q90. The minimum number of times one has to toss a fair coin so that the probability of observing at least one head is at least 90% is:

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

ANSWER KEYS

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