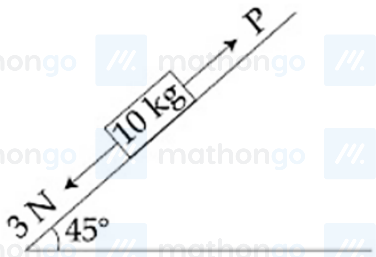
Q1. A particle is moving with a velocity $\vec{v} = Ky\hat{i} + x\hat{j}$, where K is a constant. The general equation for its path is:

(1) $y^2 = x + \text{constant}$
(2) $xy = \text{constant}$
(3) $y = x^2 + \text{constant}$
(4) $y^2 = x^2 + \text{constant}$

Q2. A copper wire is stretched to make it 0.5% longer. The percentage change in its electrical resistance if its volume remains unchanged is:

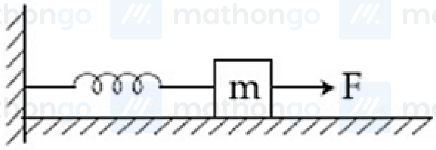
(1) 2.5%
(2) 1.0%
(3) 2.0%
(4) 0.5%

Q3. A block of mass $10\ kg$ is kept on a rough inclined plane as shown in the figure. A force of $3\ N$ is applied on the block. The coefficient of static friction between the plane and the block is 0.6. What should be the minimum value of force P, such that the block does not move downward? (take $g = 10\ ms^{-2}$)



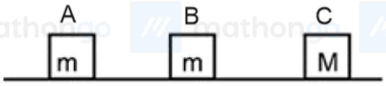
(1) $23\ N$
(2) $25\ N$
(3) $18\ N$
(4) $32\ N$

Q4. A block of mass m, lying on a smooth horizontal surface, is attached to a spring (of negligible mass) of spring constant k. The other end of the spring is fixed, as shown in the figure. The block is initially at rest in its equilibrium position. If now the block is pulled with a constant force F, the maximum speed of the block is:



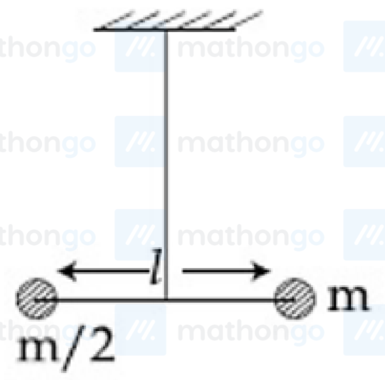
(1) $\frac{F}{\sqrt{mk}}$
(2) $\frac{2F}{\sqrt{mk}}$
(3) $\frac{\pi F}{\sqrt{mk}}$
(4) $\frac{F}{\pi\sqrt{mk}}$

Q5. Three blocks A, B and C are lying on a smooth horizontal surface, as shown in the figure. A and B have equal masses, m while C has mass M. Block A is given an initial speed v towards B due to which it collides with B perfectly inelastically. The combined mass collides with C, also perfectly inelastically . $\frac{5}{6}$th of the initial kinetic energy is lost in the whole process. What is the value of M / m?



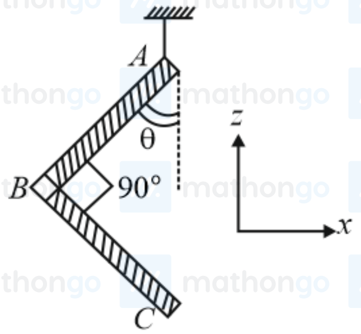
(1) 3
(2) 4
(3) 5
(4) 2

Q6. Two masses m and $\frac{m}{2}$ are connected at the two ends of a massless rigid rod of length l. The rod is suspended by a thin wire of torsional constant k at the centre of mass of the rod-mass system (see figure). Because of torsional constant k, the restoring torque is $\tau = k\theta$ for angular displacement θ. If the rod is rotated by θ_0 and released, the tension in it when it passes through its mean position will be:



(1) $k\theta_0^2$
(2) $\frac{3k\theta_0{}^2}{l}$
(3) $\frac{2k\theta_0{}^2}{l}$
(4) $\frac{k\theta_0{}^2}{l}$

Q7. An L -shaped object, made of thin rods of uniform mass density, is suspended with a string as shown in figure. If $AB = BC,$ and the angle made by AB with downward vertical is $\theta,$ then:



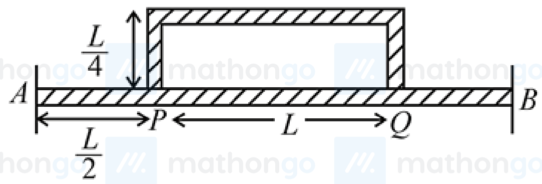
(1) $\tan\theta = \frac{2}{\sqrt{3}}$
(2) $\tan\theta = \frac{1}{3}$
(3) $\tan\theta = \frac{1}{2}$
(4) $\tan\theta = \frac{1}{2\sqrt{3}}$

Q8. If the angular momentum of a planet of mass $m,$ moving around the Sun in a circular orbit is $L,$ about the center of the Sun, its areal velocity is:
(1) $\frac{L}{m}$
(2) $\frac{4L}{m}$
(3) $\frac{L}{2m}$
(4) $\frac{2L}{m}$

Q9. A heavy ball of mass M is suspended from the ceiling of a car by a light string of mass $m\, m \ll M$. When the car is at rest, the speed of transverse waves in the string is 60 ms^{-1}. When the car has acceleration $a,$ the wave-speed increases to 60.5 ms^{-1}. The value of $a,$ in terms of gravitational acceleration $g,$ is closed to
(1) $\frac{g}{10}$
(2) $\frac{g}{20}$
(3) $\frac{g}{5}$
(4) $\frac{g}{30}$

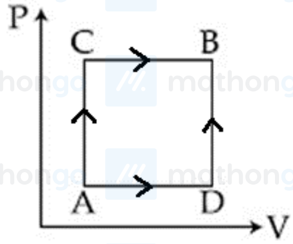
Q10. A rod, of length L at room temperature and uniform area of cross section $A,$ is made of a metal having coefficient of linear expansion $\alpha \quad / °C$ It is observed that an external compressive force F is applied on each of its ends, prevents any change in the length of the rod when its temperature rises by $\Delta T \quad$ K Young's modulus, Y for this metal is:
(1) $\frac{F}{A\alpha\Delta T - 273}$
(2) $\frac{2F}{A\alpha\Delta T}$
(3) $\frac{F}{A\alpha\Delta T}$
(4) $\frac{F}{2A\,\alpha\Delta T}$

Q11. Temperature difference of $120^{o}C$ is maintained between two ends of a uniform rod AB of length $2L$. Another bent rod PQ, of same cross-section as AB and length $\frac{3L}{2}$, is connected across AB (See figure). In steady state, temperature difference between P and Q will be close to:



(1) $45^{o}C$
(2) $35^{o}C$
(3) $60^{o}C$
(4) $75^{o}C$

Q12. A gas can be taken from A to B via two different processes ACB and ADB.



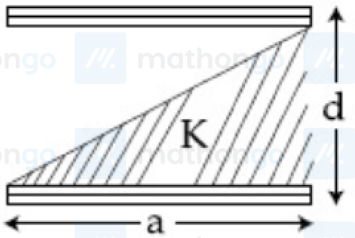
When path ACB is used 60 J of heat flows into the system and 30 J of work is done by the system. If the path ADB is used then work done by the system is 10 J, the heat flows into the system in the path ADB is:
(1) 100 J
(2) 20 J
(3) 40 J
(4) 80 J

Q13. A mixture of 2 moles of helium gas (atomic mass = 4u) , and 1 mole of argon gas (atomic mass = 40 u) is kept at 300 K in a container. The ratio of their rms speeds $\frac{V_{rms} helium}{V_{rms}(argon)}$, is close to:
(1) 0.45
(2) 2.24
(3) 0.32
(4) 3.16

Q14. Three charges $+Q$, q, $+Q$ are placed respectively, at distance, $0, d / 2$ and d from the origin, on the x -axis. If the net force experienced by $+Q$, placed at $x = 0$, is zero, then value of q is:
(1) $+Q / 2$
(2) $+Q / 4$
(3) -$Q / 4$
(4) -$Q / 2$

Q15. For a uniformly charged ring of radius R, the electric field on its axis has the largest magnitude at a distance h from its centre. Then value of h is:
(1) $\frac{R}{\sqrt{2}}$
(2) $\frac{R}{\sqrt{5}}$
(3) $R\sqrt{2}$
(4) R

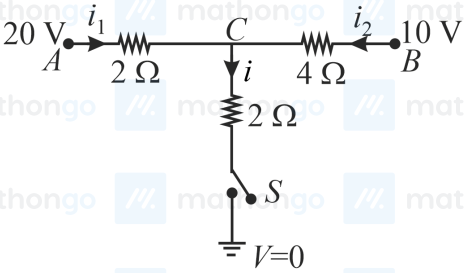
Q16. A parallel plate capacitor is made of two square plates of side a, separated by a distance $d\ d \ll a$. The lower triangular portion filled with a dielectric of dielectric constant K, as shown in the figure. Capacitance of this capacitor is:



(1) $\frac{K\varepsilon_0 a^2}{2dK+1}$ (2) $\frac{K\varepsilon_0 a^2}{dK-1}\ln K$

(3) $\frac{K\varepsilon_0 a^2}{d}\ln K$ (4) $\frac{1}{2}\frac{K\varepsilon_0 a^2}{d}$

Q17. When the switch $S,$ in the circuit shown, is closed, then the value of current i will be:



(1) 2 A (2) 5 A

(3) 3 A (4) 4 A

Q18. Drift speed of electrons, when 1.5 A current flows in a copper wire of cross section 5 mm^2 is v_d. If the electron density in copper is 9×10^{28} m^{-3} the value of v_d in mm s^{-1} is close to (Take charge of an electron to be $=1.6\times10^{-19}$ C)

(1) 0.2 (2) 3

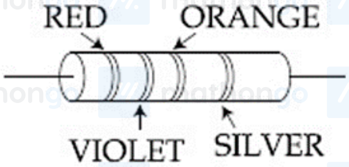
(3) 2 (4) 0.02

Q19. Mobility of electrons in a semiconductor is defined as the ratio of their drift velocity to the applied electric field. If, for an N-type semiconductor, the density of electrons is 10^{19} m^{-3} and their mobility is 1.6 m^2 V^{-1} s^{-1}, then the resistivity of the semiconductor (since it is an N-type semiconductor contribution of holes is ignored) is close to:

(1) 0.2 Ω m (2) 4 Ω m

(3) 2 Ω m (4) 0.4 Ω m

Q20. A resistance is shown in the figure. Its value and tolerance are given respectively by:



(1) 27 $k\Omega$, 10% (2) 270 Ω, 5%

(3) 270 Ω, 10% (4) 27 $k\Omega$, 20%

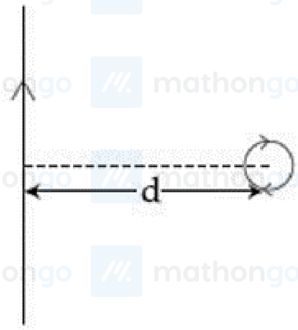
Q21. A bar magnet is demagnetized by inserting it inside a solenoid of length $0.2\ m$, 100 turns, and carrying a current of $5.2\ A$. The coercivity of the bar magnet is:

(1) $285\ A/m$
(2) $2600\ A/m$
(3) $520\ A/m$
(4) $1200\ A/m$

Q22. A current loop, having two circular arcs joined by two radial lines is shown in the figure. It carries a current of $10\ A$. The magnetic field at point O will be close to:

(1) $1.5\times10^{-7}\ T$
(2) $1.0\times10^{-7}\ T$
(3) $1.5\times10^{-5}\ T$
(4) $1.0\times10^{-5}\ T$

Q23. An infinitely long current carrying wire and a small current carrying loop are in the plane of the paper as shown. The radius of the loop is a and distance of its centre from the wire is d $d \gg a$. If the loop applies a force F on the wire then:



(1) $F\propto\frac{a^2}{d}$
(2) $F=0$
(3) $F\propto\frac{a^2}{d^3}$
(4) $F\propto\frac{a}{d}$

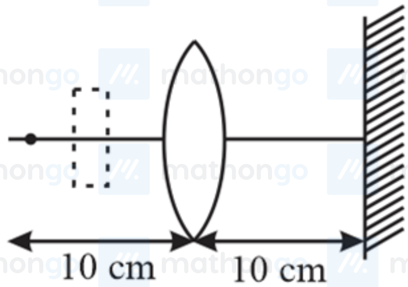
Q24. A conducting circular loop made of a thin wire has area $3.5\times10^{-2}\ m^2$ and resistance $10\ \Omega$ It is placed perpendicular to a time-dependent magnetic field $Bt=0.4\ \ \text{T}\sin 50\pi t$ The field is uniform in space. Then the net charge flowing through the loop during $t=0$ s and $t=10$ ms is close to

(1) $1.4\ mC$
(2) $7\ mC$
(3) $21\ mC$
(4) $6\ mC$

Q25. A plane electromagnetic wave of frequency $50\ MHz$ travels in free space along the positive x - direction. At a particular point in space and time, $\vec{E}=6.3\ \hat{j}\ V/m$, The corresponding magnetic field $\vec{B}$, at that point will be:

(1) $2.1\times10^{-8}\hat{k}\ T$
(2) $18.9\times10^{8}\hat{k}\ T$
(3) $18.9\times10^{-8}\hat{k}\ T$
(4) $6.3\times10^{-8}\hat{k}\ T$

Q26. A convex lens is put $10\ cm$ from a light source and it makes a sharp image on a screen, kept $10\ cm$ from the lens. Now a glass block (refractive index 1.5) of $1.5\ cm$ thickness is placed in between the light source and the lens. To get the sharp image again, the screen is shifted by a distance d. Then d is:

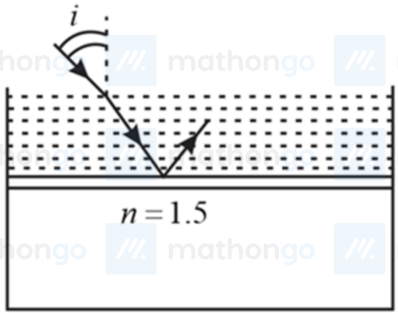


(1) 0
(2) 0.55 cm away from the lens
(3) 0.55 cm towards the lens
(4) 1.1 cm away from the lens

Q27. Two coherent sources produce waves of different intensities which interfere. After interference, the ratio of the maximum intensity to the minimum intensity is 16. The intensity of the waves are in the ratio:

(1) $25:9$
(2) $16:9$
(3) $5:3$
(4) $4:1$

Q28. Consider a tank made of glass (refractive index 1.5) with a thick bottom. It is filled with a liquid of refractive index μ. A student finds that, irrespective of what the incident angle i (see figure) is for a beam of light entering the liquid, the light reflected from the liquid glass interface is never completely polarized. For this to happen, the minimum value of μ is:



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

Q29. The surface of certain metal is first illuminated with light of wavelength $\lambda_1 = 350$ nm and then, by a light of wavelength $\lambda_2 = 540$ nm. It is found that the maximum speed of the photoelectrons in the two cases differ by a factor of 2. The work function of the metal (in eV) is close to
(Energy of photon $= \frac{1240}{\lambda \text{in nm}}$ eV)

(1) 2.5
(2) 1.8
(3) 5.6
(4) 1.4

Q30. A Sample of radioactive material A, that has an activity of $10\ m$ Ci $1\ Ci = 3.7 \times 10^{10}$ decays s^{-1}, has twice the number of nuclei as another sample of a different radioactive material B which has an activity of $20\ m$ Ci. The correct choices for half-lives of A and B would then be, respectively:

(1) 5 days and 10 days
(2) 10 days and 40 days
(3) 20 days and 10 days
(4) 20 days and 5 days

Q31. For emission line of atomic hydrogen from $n_i = 8$ to $n_f = n$, the plot of wave number $\bar{v}$ against $\frac{1}{n^2}$ will be:
(The Rydberg constant, R_H is in wave number unit)

(1) Linear with slope $-R_H$
(2) Non linear
(3) Linear with slope R_H
(4) Linear with intercept $-R_H$

Q32. In general, the properties that decrease and increase down a group in the periodic table, respectively, are :

(1) Atomic radius and electronegativity
(2) Electronegativity and atomic radius
(3) Electronegativity and electron gain enthalpy
(4) Electron gain enthalpy and electronegativity

Q33. Aluminium is usually found in +3 oxidation state. In contrast, thallium exists in +1 and +3 oxidation states. This is due to:

(1) Diagonal relationship
(2) Lattice effect
(3) Lanthanoid contraction
(4) Inert pair effect

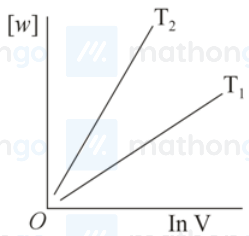
Q34. According to molecular orbital theory, which of the following is true with respect to Li_2^+ and Li_2^- ?

(1) Li_2^+ is stable and Li_2^- is unstable
(2) Both are unstable
(3) Both are stable
(4) Li_2^+ is unstable and Li_2^- is stable

Q35. 0.5 moles of gas A and x moles of gas B exert a pressure of 200 Pa in a container of volume $10\ m^3$ at 1000 K . Given, R is the gas constant in $JK^{-1}mol^{-1}$, x is:

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

Q36. Consider the reversible isothermal expansion of an ideal gas in a closed system at two different temperatures T_1 and $T_2 T_1 < T_2$. The correct graphical depiction of the dependence of work done w vs the final volume V is:

(1)


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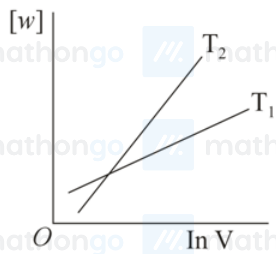

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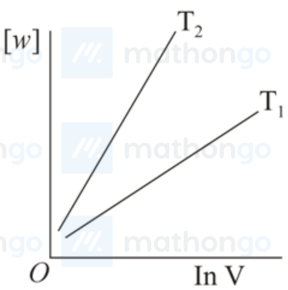

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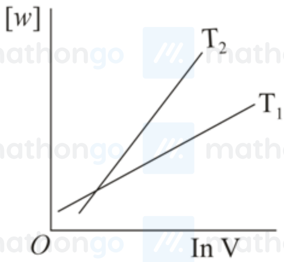


Q37. 20 ml of 0.1 M H_2SO_4 solution is added to 30 mL of 0 .2 M NH_4OH solution. The pH of the resultant mixture is: pk_b of $NH_4OH = 4\ .7$

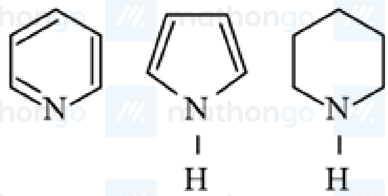
(1) 5.0
(2) 5.2
(3) 9.4
(4) 9.0

Q38. The isotopes of hydrogen are:
(1) Protium, deuterium and tritium
(2) Tritium and protium only
(3) Protium and deuterium only
(4) Deuterium and tritium only

Q39. The alkaline earth metal nitrate that does not crystallise with molecules is:
(1) $BaNO_{3_2}$
(2) $SrNO_{3_2}$
(3) $MgNO_{3_2}$
(4) $CaNO_{3_2}$

Q40. Correct statements among regarding silicones are:
(a) They are polymers with hydrophobic character.
(b) They are biocompatible.
(c) In general, they have high thermal stability and low dielectric strength.
(d) Usually, they are resistant to oxidation and used as greases.
(1) (a), (b) and (c) only
(2) (a) and (b) only
(3) (a), (b), (c) and (d)
(4) (a), (b) and (d) only

Q41. Arrange the following amines in the decreasing order of basicity.

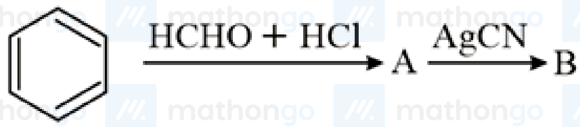


I II III

(1) III > I > II
(2) I > III > II
(3) III > II > I
(4) I > II > III

Q42. Which amongst the following is the strongest acid?
(1) $CHCN_3$
(2) CHI_3
(3) $CHBr_3$
(4) $CHCl_3$

Q43. The compounds A and B in the following reaction are, respectively:



(1) $A =$ Benzyl alcohol, $B =$ Benzyl isocyanide
(2) $A =$ Benzyl chloride, $B =$ Benzyl isocyanide
(3) $A =$ Benzyl alcohol, $B =$ Benzyl cyanide
(4) $A =$ Benzyl chloride, $B =$ Benzyl cyanide

Q44. A water sample has ppm level concentration of the following metals:
Fe = 0 .2 ; Mn = 5 .0 ; Cu = 3 .0 ; Zn = 5 .0 .
The metal that makes the water sample unsuitable for drinking is
(1) Zn
(2) Fe
(3) Mn
(4) Cu

Q45. The one that is extensively used as a piezoelectric material is:
(1) Tridymite
(2) Quartz
(3) Amorphous silica
(4) Mica

Q46. A solution of sodium sulphate contains 92 g of Na^+ ions per kilogram of water. The molality of Na^+ ions in that solution in mol kg^{-1} is:

(1) 16
(2) 4
(3) 12
(4) 8

Q47. Which one of the following statements regarding Henry's law is not correct?

(1) Different gases have different K_H (Henry's law constant) values at the same temperature
(2) The partial pressure of the gas in vapour phase is proportional to the mole fraction of the gas in the solution
(3) Higher the value of K_H at a given pressure, higher is the solubility of the gas in the liquids
(4) The value of K_H increases with increase of temperature and K_H is function of the nature of the gas

Q48. The anodic half-cell of lead-acid battery is recharged using electricity of 0 .05 Faraday. The amount of $PbSO_4$ electrolyzed in g during the process is: (Molar mass of $PbSO_4 = 303 g\ mol^{-1}$)

(1) 22.8
(2) 15.2
(3) 11.4
(4) 7.6

Q49. The following results were obtained during kinetic studies of the reaction.

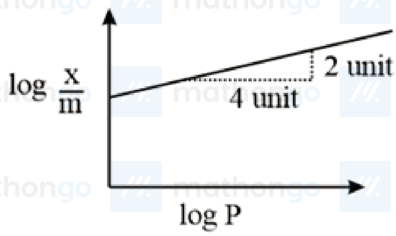
$2A + B \rightarrow$ product

Experiment	A in mol L^{-1}	B in mol L^{-1}	Initial rate of reaction in mol L^{-1} min^{-1}
I	0.10	0.20	6.93×10^{-3}
II	0.10	0.25	6.93×10^{-3}
III	0.20	0.30	1.386×10^{-2}

The time (in minutes) required to consume half of A is

(1) 100
(2) 10
(3) 5
(4) 1

Q50. Adsorption of a gas follows Freundlich adsorption isotherm. In the given plot, x is the mass of the gas adsorbed on mass m of the adsorbent at pressure P . $\frac{x}{m}$ is proportional to:



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

Q51. The ore that contains both iron and copper is:

(1) Azurite
(2) Malachite
(3) Dolomite
(4) Copper pyrites

Q52. The major product of the following reaction is,

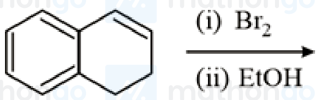
$$R-C\equiv N \xrightarrow[(2)\ H_2O]{(1)\ AlH\,(i-Bu)_2}$$

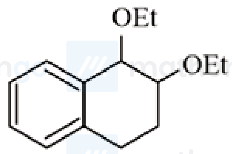
(1) RCOOH
(2) RCHO
(3) RCH_2NH_2
(4) $RCONH_2$

Q53. Two complexes $CrH_2O_6Cl_3$ A and $CrNH_{3_6}Cl_3$B are violet and yellow coloured, respectively, The incorrect statement regarding them is:

(1) Both are paramagnetic with three unpaired electrons
(2) Δ_0 value of A is less than that of B
(3) Δ_0 values of A and B are calculated from the energies violet and yellow light, respectively.
(4) Both absorb energies corresponding to their complementary colors.

Q54. In the reaction given below what will be the major product at the end :



(1)


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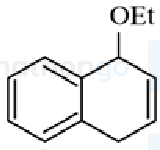

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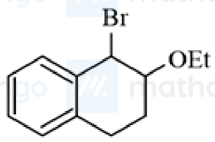
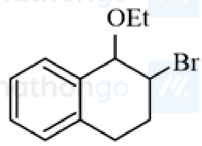
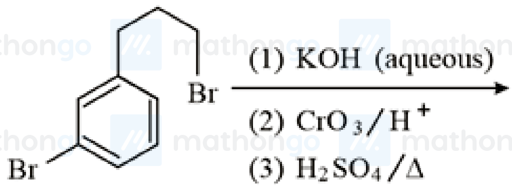
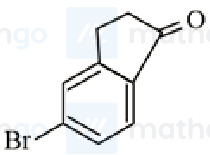


(4)


Q55. Major product of the given reaction is:



(1)


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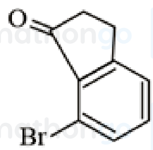
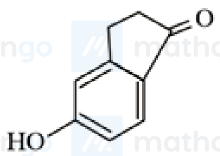
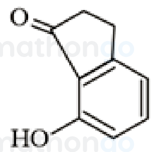


(3)


(4)


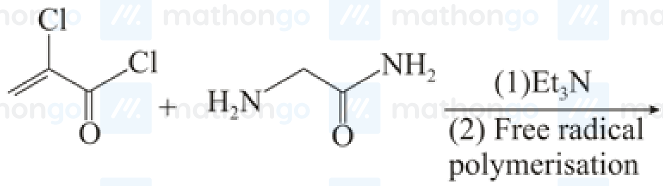
Q56. The highest value of the calculated spin only magnetic moment (in BM) among all the transition metal complexes is

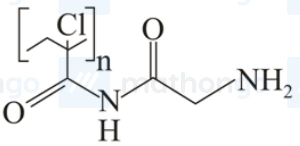
(1) 4 .90 BM
(2) 3 .87 BM
(3) 6 .93 BM
(4) 5 .92 BM

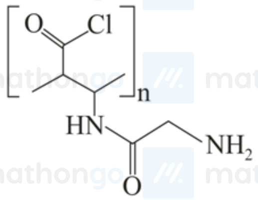
Q57. Acid strength given below the correct decreasing order will be :

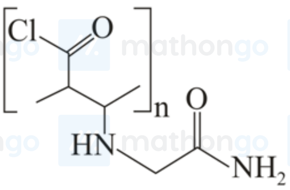
(1) $NO_2CH_2COOH > FCH_2COOH > CNCH_2COOH > ClCH_2COOH$
(2) $NO_2CH_2COOH > NCCH_2COOH > FCH_2COOH > ClCH_2COOH$
(3) $CNCH_2COOH > O_2NCH_2COOH > FCH_2COOH > ClCH_2COOH$
(4) $FCH_2COOH > NCCH_2COOH > NO_2CH_2COOH > ClCH_2COOH$

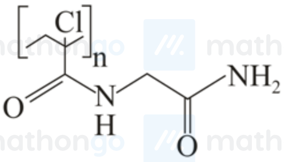
Q58. Major product of the given below reaction:



(1)


(2)


(3)


(4)


Q59. The correct match between column-I and column-II is

Column-I (drug)	Column-II (test)
(A) Chloroxylenol	(P) Carbylamine test
(B) Norethindrone	(Q) Sodium hydrogen carbonate test
(C) Sulphapyridine	(R) Ferric chloride test
(D) Penicillin	(S) Baeyer's test

(1) A → R, B → P, C → S, D → Q
(2) A → Q, B → S, C → P, D → R
(3) A → Q, B → P, C → S, D → R
(4) A → R, B → S, C → P, D → Q

Q60. The increasing order of pKa of the following amino acids in aqueous solution is
Glycine, Aspartate, Lysine, Arginine.

(1) Arginine < Lysine < Glycine < Aspartate
(2) Aspartate < Glycine < Arginine < Lysine
(3) Glycine < Aspartate < Arginine < Lysine
(4) Aspartate < Glycine < Lysine < Arginine

Q61. Let α and β be the roots of the equation $x^2 + 2x + 2 = 0,$ then $\alpha^{15} + \beta^{15}$ is equal to

(1) -512
(2) 128
(3) 512
(4) -256

Q62. Let $A = \theta \in -\frac{\pi}{2}, \pi : \frac{3+2i\ \sin\theta}{1-2i\sin\theta}$ is purely imaginary . Then the sum of the elements in A is:

(1) $\frac{5\pi}{6}$
(2) π
(3) $\frac{2\pi}{3}$
(4) $\frac{3\pi}{4}$

Q63. Consider a class of 5 girls and 7 boys. The number of different teams consisting of 2 girls and 3 boys that can be formed from this class, if there are two specific boys A and $B,$ who refuse to be the members of the same team, is:

(1) 300
(2) 200
(3) 500
(4) 350

Q64. If $a,\ b$ and c be three distinct real numbers in G.P. and $a+b+c=xb,$ then x cannot be:

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

Q65. Let $a_1,\ a_2,\ \ldots,\ a_{30}$ be an A.P., $S=\ \sum_{i=1}^{30} a_i$ and $T=\ \sum_{i=1}^{15} a_{(2i-1)}$. If $a_5=27$ and $S-2T=75,$ then a_{10} is equal to:

(1) 52
(2) 47
(3) 42
(4) 57

Q66. If the fractional part of the number $\frac{2^{403}}{15}$ is $\frac{k}{15},$ then k is equal to

(1) 4
(2) 14
(3) 8
(4) 6

Q67. For any $\theta \in \frac{\pi}{4}, \frac{\pi}{2},$ the expression $3\sin\theta - \cos\theta^4 + 6\sin\theta + \cos\theta^2 + 4\ \sin^6\theta$ equals:

(1) $13 - 4\cos^2\theta + 6\cos^4\theta$
(2) $13 - 4\cos^2\theta + 6\sin^2\theta\cos^2\theta$
(3) $13 - 4\cos^6\theta$
(4) $13 - 4\cos^4\theta + 2\sin^2\theta\cos^2\theta$

Q68. Consider the set of all lines $px+qy+r=0$ such that $3p+2q+4r=0$. Which one of the following statements is true?

(1) The lines are not concurrent.
(2) The lines are concurrent at the point $\frac{3}{4}, \frac{1}{2}$.
(3) The lines are all parallel.
(4) Each line passes through the origin.

Q69. Three circles of radii $a,\ b,\ c,\ a<b<c$ touch each other externally. If they have $x-$ axis as a common tangent, then:

(1) $\frac{1}{\sqrt{a}}=\frac{1}{\sqrt{b}}+\frac{1}{\sqrt{c}}$
(2) $a,\ b,\ c$ are in A.P.
(3) $\frac{1}{\sqrt{b}}=\frac{1}{\sqrt{a}}+\frac{1}{\sqrt{c}}$
(4) $\sqrt{a},\ \sqrt{b},\ \sqrt{c}$ are in A.P.

Q70. Axis of a parabola lies along x-axis. If its vertex and focus are at distances 2 and 4 respectively from the origin, on the positive x-axis then which of following points does not lie on it?

(1) $6, 4\sqrt{2}$
(2) $5, 2\sqrt{6}$
(3) $8, 6$
(4) $4, -4$

Q71. Equation of a common tangent to the circle, $x^2+y^2-6x=0$ and the parabola, $y^2=4x$ is:

(1) $2\sqrt{3}y=\ -x-12$
(2) $\sqrt{3}y=x+3$
(3) $\sqrt{3}y=3x+1$
(4) $2\sqrt{3}y=12x+1$

Q72. Let $0<\theta<\frac{\pi}{2}$. If the eccentricity of the hyperbola $\frac{x^2}{\cos^2\theta}-\frac{y^2}{\sin^2\theta}=1$ is greater than 2, then the length of its latus rectum lies in the interval:

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

Q73. The value of $\lim_{y\to 0}\frac{\sqrt{1+\sqrt{1+y^4}}-\sqrt{2}}{y^4}$

(1) exists and equals $\frac{1}{2\sqrt{2}}$
(2) exists and equals $\frac{1}{4\sqrt{2}}$
(3) does not exist
(4) exists and equals $\frac{1}{2\sqrt{2}\sqrt{2}+1}$

Q74. If the Boolean expression $p \oplus q \wedge \sim p \odot q$ is equivalent to $p \wedge q$, where $\oplus, \odot \in \wedge, \vee$, then the ordered pair $\oplus, \odot$ is
(1) $\vee, \wedge$
(2) $\wedge, \wedge$
(3) $\vee, \vee$
(4) $\wedge, \vee$

Q75. 5 students of a class have an average height 150 cm and variance 18 cm^2. A new student, whose height is 156 cm, joined them. The variance in cm^2 of the height of these six students is:
(1) 22
(2) 16
(3) 18
(4) 20

Q76. If $A = \begin{matrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{matrix}$, then the matrix A^{-50} when $\theta = \frac{\pi}{12}$, is equal to:
(1) $\begin{matrix} \frac{\sqrt{3}}{2} & \frac{1}{2} \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} \end{matrix}$
(2) $\begin{matrix} \frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} \end{matrix}$
(3) $\begin{matrix} \frac{\sqrt{3}}{2} & -\frac{1}{2} \\ \frac{1}{2} & \frac{\sqrt{3}}{2} \end{matrix}$
(4) $\begin{matrix} \frac{1}{2} & -\frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & \frac{1}{2} \end{matrix}$

Q77. The system of linear equations
$x + y + z = 2$
$2x + 3y + 2z = 5$
$2x + 3y + a^2 - 1z = a + 1$
(1) is inconsistent when $a = \sqrt{3}$
(2) has a unique solution for $a = \sqrt{3}$
(3) has infinitely many solutions for $a = 4$
(4) is inconsistent when $a = 4$

Q78. If $\cos^{-1}\frac{2}{3x} + \cos^{-1}\frac{3}{4x} = \frac{\pi}{2}\ x > \frac{3}{4}$, then x is equal to :
(1) $\frac{\sqrt{145}}{10}$
(2) $\frac{\sqrt{145}}{11}$
(3) $\frac{\sqrt{146}}{12}$
(4) $\frac{\sqrt{145}}{12}$

Q79. For $x \in R - 0,\ 1$, let $f_1 x = \frac{1}{x}, f_2 x = 1 - x$ and $f_3 x = \frac{1}{1 - x}$ be three given functions. If a function, Jx satisfies $f_2 oJof_1 x = f_3 x$ then Jx is equal to:
(1) $f_3 x$
(2) $\frac{1}{x} f_3 x$
(3) $f_1 x$
(4) $f_2 x$

Q80. Let $f: R \to R$ be a function defined as

$$fx = \begin{matrix} 5, & if & x \le 1 \\ a + bx, & if & 1 < x < 3 \\ b + 5x, & if & 3 \le x < 5 \\ 30, & if & x \ge 5 \end{matrix}$$

Then f is:
(1) continuous if $a = -5$ and $b = 10$
(2) continuous if $a = 0$ and $b = 5$
(3) not continuous for any values of a and b
(4) continuous if $a = 5$ and $b = 5$

Q81. The maximum volume in $cu.m$ of the right circular cone having slant height 3 m is:

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

Q82. If θ denotes the acute angle between the curves, $y = 10 - x^2$ and $y = 2 + x^2$ at a point of their intersection, then $\tan\theta$ is equal to:
(1) $\frac{4}{9}$
(2) $\frac{8}{17}$
(3) $\frac{7}{17}$
(4) $\frac{8}{15}$

Q83. For, $x^2 \neq n\pi + 1, \quad n \in N$ (the set of natural numbers), the integral $\int x\sqrt{\frac{2\sin x^2 - 1 - \sin 2x^2 - 1}{2\sin x^2 - 1 + \sin 2x^2 - 1}}dx$, is equal to (where c is a constant of integration).
(1) $\log_e \sec\frac{x^2 - 1}{4} + c$
(2) $\log_e \frac{1}{2}\sec^2 x^2 - 1 + c$
(3) $\frac{1}{2}\log_e \sec x^2 - 1 + c$
(4) $\log_e \sec^2\frac{x^2 - 1}{2} + c$

Q84. The value of $\int_0^{\pi} \cos x^3 dx$ is
(1) $\frac{2}{3}$
(2) 0
(3) $\frac{4}{3}$
(4) $-\frac{4}{3}$

Q85. The area (in sq. units) bounded by the parabola $y = x^2 - 1$, the tangent at the point $2, 3$ to it and the y-axis is
(1) $\frac{14}{3}$
(2) $\frac{8}{3}$
(3) $\frac{32}{3}$
(4) $\frac{56}{3}$

Q86. If $y = y(x)$ is the solution of the differential equation, $x\frac{dy}{dx} + 2y = x^2$ satisfying $y1 = 1$, then $y\frac{1}{2}$ is equal to
(1) $\frac{7}{64}$
(2) $\frac{1}{4}$
(3) $\frac{13}{16}$
(4) $\frac{49}{16}$

Q87. Let $\vec{a} = \hat{i} - \hat{j}$, $\vec{b} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{c}$ be a vector such that $\vec{a} \times \vec{c} + \vec{b} = \vec{0}$ and $\vec{a} \cdot \vec{c} = 4$, then $\left|\vec{c}\right|^2$ is equal to:
(1) $\frac{19}{2}$
(2) 9
(3) $\frac{17}{2}$
(4) 8

Q88. The plane through the intersection of the planes $x + y + z = 1$ and $2x + 3y - z + 4 = 0$ and parallel to y-axis also passes through the point
(1) $3, 3, -1$
(2) $-3, 1, 1$
(3) $3, 2, 1$
(4) $-3, 0, -1$

Q89. The equation of the line passing through $-4, 3, 1$, parallel to the plane $x + 2y - z - 5 = 0$ and intersecting the line $\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z-2}{-1}$ is
(1) $\frac{x+4}{3} = \frac{y-3}{-1} = \frac{z-1}{1}$
(2) $\frac{x+4}{1} = \frac{y-3}{1} = \frac{z-1}{3}$
(3) $\frac{x+4}{-1} = \frac{y-3}{1} = \frac{z-1}{1}$
(4) $\frac{x-4}{2} = \frac{y+3}{1} = \frac{z+1}{4}$

Q90. Two cards are drawn successively with replacement from a well-shuffled deck of 52 cards. Let X denote the random variable of number of aces obtained in the two drawn cards. Then $PX = 1 + PX = 2$ equals:
(1) $\frac{24}{169}$
(2) $\frac{52}{169}$
(3) $\frac{49}{169}$
(4) $\frac{25}{169}$

ANSWER KEYS

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