Q1. A particle of mass m is moving along a trajectory given by

$x = x_0 + \mathrm{a}\cos\omega_1 \mathrm{t}$

$y = y_0 + \mathrm{b}\sin\omega_2 \mathrm{t}$

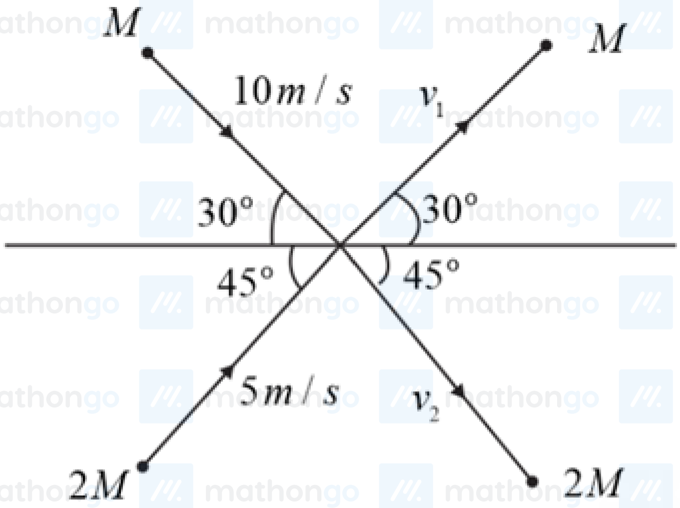
The torque, acting on the particle about the origin, at $\mathrm{t} = 0$ is:

(1) $+\mathrm{m}y_0\mathrm{a}\omega_1^2\hat{\mathrm{k}}$
(2) $-\mathrm{m}\left(x_0\mathrm{b}\omega_2^2 - y_0\mathrm{a}\omega_1^2\right)\hat{\mathrm{k}}$
(3) Zero
(4) $\mathrm{m}(-x_0\mathrm{b} + y_0\mathrm{a})\omega_1^2\hat{\mathrm{k}}$

Q2. A ball is thrown upward with an initial velocity V_0 from the surface of the earth. The motion of the ball is affected by a drag force equal to $\mathrm{m}\gamma v^2$ (where m is mass of the ball, v is its instantaneous velocity and γ is a constant). Time taken by the ball to rise to its zenith is:

(1) $\frac{1}{\sqrt{\gamma \mathrm{g}}}\ln\left(1 + \sqrt{\frac{\gamma}{\mathrm{g}}}\mathrm{V}_0\right)$
(2) $\frac{1}{\sqrt{\gamma \mathrm{g}}}\tan^{-1}\left(\sqrt{\frac{\gamma}{\mathrm{g}}}\mathrm{V}_0\right)$
(3) $\frac{1}{\sqrt{\gamma \mathrm{g}}}\sin^{-1}\left(\sqrt{\frac{\gamma}{\mathrm{g}}}\mathrm{V}_0\right)$
(4) $\frac{1}{\sqrt{2\gamma \mathrm{g}}}\tan^{-1}\left(\sqrt{\frac{2\gamma}{\mathrm{g}}}\mathrm{V}_0\right)$

Q3. Two particles of masses M and 2M are moving with speeds of 10 m s^{-1} and 5 m s^{-1}, as shown in the figure. They collide at the origin and after that they move along the indicated directions with speeds v_1 and v_2, respectively. The values of v_1 and v_2 are, nearly



(1) 6.5 m s^{-1} and 3.2 m s^{-1}
(2) 3.2 m s^{-1} and 12.6 m s^{-1}
(3) 13.02 m s^{-1} and 19.7 m s^{-1}
(4) 3.2 m s^{-1} and 6.3 m s^{-1}

Q4. A thin disc of mass M and radius R has mass per unit area $\sigma(\mathrm{r}) = \mathrm{kr}^2$ where r is the distance from its centre. Its moment inertia about an axis going through its centre of mass and perpendicular to its plane is:

(1) $\frac{\mathrm{MR}^2}{3}$
(2) $\frac{\mathrm{MR}^2}{2}$
(3) $\frac{\mathrm{MR}^2}{6}$
(4) $\frac{2\mathrm{MR}^2}{3}$

Q5. Two coaxial discs, having moments of inertia I_1 and $\frac{I_1}{2}$, are rotating with respective angular velocities ω_1 and $\frac{\omega_1}{2}$, about their common axis. They are brought in contact with each other and thereafter they rotate with a common angular velocity. If E_f and E_i are the final and initial total energies, then $(E_f - E_i)$ is:

(1) $\frac{I_1\omega_1^2}{6}$
(2) $\frac{3}{8}I_1\omega_1^2$
(3) $-\frac{I_1\omega_1^2}{12}$
(4) $-\frac{I_1\omega_1^2}{24}$

Q6. The value of acceleration due to gravity at Earth's surface is $9.8 \mathrm{~m~s}^{-2}$. The altitude above its surface at which the acceleration due to gravity decreases to $4.9 \mathrm{~m~s}^{-2}$, is close to: (Radius of earth $= 6.4 \times 10^{6} \mathrm{~m}$)

(1) $1.6 \times 10^{6} \mathrm{~m}$
(2) $2.6 \times 10^{6} \mathrm{~m}$
(3) $6.4 \times 10^{6} \mathrm{~m}$
(4) $9.0 \times 10^{6} \mathrm{~m}$

Q7. The ratio of surface tensions of mercury and water is given to be 7.5, while the ratio of their densities is 13.6. Their contact angles, with glass, are close to 135° and 0°, respectively. If it is observed that mercury gets depressed by an amount h in a capillary tube of radius r_1, while water rises by the same amount h in a capillary tube of radius r_2, then the ratio $\frac{r_1}{r_2}$ is close to

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

Q8. n moles of an ideal gas with constant volume heat capacity $\mathrm{C_v}$ undergo an isobaric expansion by certain volume. The ratio of the work done in the process, to the heat supplied is:

(1) $\frac{4\mathrm{nR}}{\mathrm{C_v}+\mathrm{nR}}$
(2) $\frac{4\mathrm{nR}}{\mathrm{C_v}-\mathrm{nR}}$
(3) $\frac{\mathrm{nR}}{\mathrm{C_v}+\mathrm{nR}}$
(4) $\frac{\mathrm{nR}}{\mathrm{C_v}-\mathrm{nR}}$

Q9. A cylinder with fixed capacity of 67.2 litre contains helium gas at STP. The amount of heat needed to raise the temperature of the gas by $20^{\circ}\mathrm{C}$ is:
[Given that $\mathrm{R} = 8.31 \mathrm{~J~mol}^{-1} \mathrm{~K}^{-1}$]

(1) 748 J
(2) 700 J
(3) 350 J
(4) 374 J

Q10. A $25 \times 10^{-3} \mathrm{~m}^{3}$ volume cylinder is filled with 1 mol of $\mathrm{O_2}$ gas at room temperature $(300 \mathrm{~K})$. The molecular diameter of $\mathrm{O_2}$, and its root mean square speed, are found to be $0.3 \mathrm{~nm}$ and $200 \mathrm{~m/s}$, respectively. What is the average collision rate (per second) for an $\mathrm{O_2}$ molecule?

(1) ~10^{11}
(2) ~10^{12}
(3) ~10^{10}
(4) ~10^{13}

Q11. The displacement of a damped harmonic oscillator is given by $x(\mathrm{t}) = \mathrm{e}^{-0.1\mathrm{t}} \cos(10\pi\mathrm{t} + \varphi)$. Here t is in seconds. The time taken for its amplitude of vibration to drop to half of its initial value is close to:

(1) 27 s
(2) 4 s
(3) 13 s
(4) 7 s

Q12. A stationary source emits sound waves of frequency $500 \mathrm{~Hz}$. Two observers moving along a line passing through the source detect sound to be of frequencies 480 Hz and $530 \mathrm{~Hz}$. Their respective speeds are, in $\mathrm{m~s}^{-1}$,
(Given speed of sound $= 300 \mathrm{~m/s}$)

(1) $16,\ 14$
(2) $12,\ 16$
(3) $12,\ 18$
(4) $8,\ 18$

Q13. A uniformly charged ring of radius $3a$ and total charge q is placed in x-y plane centred at origin. A point charge q is moving towards the ring along the $z-$ axis and has speed v at $z = 4a$. The minimum value of v such that it crosses the origin is:

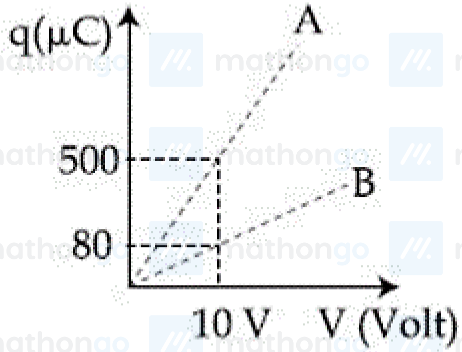
(1) $\sqrt{\frac{2}{m}}\left(\frac{1}{15}\frac{q^2}{4\pi\epsilon_0 a}\right)^{1/2}$

(2) $\sqrt{\frac{2}{m}}\left(\frac{4}{15}\frac{q^2}{4\pi\epsilon_0 a}\right)^{1/2}$

(3) $\sqrt{\frac{2}{m}}\left(\frac{1}{5}\frac{q^2}{4\pi\epsilon_0 a}\right)^{1/2}$

(4) $\sqrt{\frac{2}{m}}\left(\frac{2}{15}\frac{q^2}{4\pi\epsilon_0 a}\right)^{1/2}$

Q14. Figure shows charge (q) versus voltage (V) graph for series and parallel combination of two given capacitors. The capacitances are:

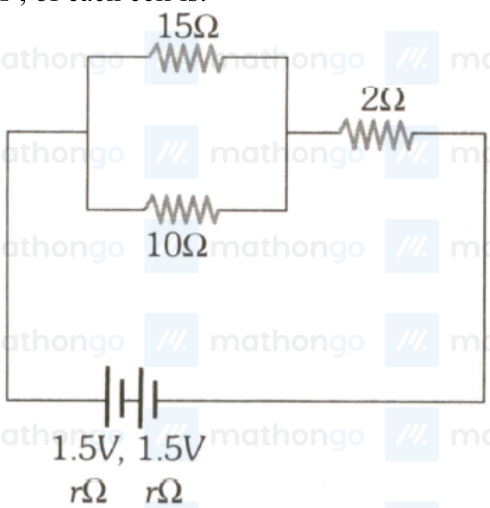


(1) 60 μF and 40 μF
(2) 50 μF and 30 μF
(3) 20 μF and 30 μF
(4) 40 μF and 10 μF

Q15. A current of 5 A passes through a copper conductor (resistivity $= 1.7 \times 10^{-8}\ \Omega\ \mathrm{m}$) of radius of cross-section 5 mm . Find the mobility of the charges if their drift velocity is $1.1 \times 10^{-3}\ \mathrm{ms}^{-1}$.

(1) $1.5\ \mathrm{m}^2\ \mathrm{V}^{-1}\ \mathrm{s}^{-1}$
(2) $1.8\ \mathrm{m}^2\ \mathrm{V}^{-1}\ \mathrm{s}^{-1}$
(3) $1.0\ \mathrm{m}^2\ \mathrm{V}^{-1}\ \mathrm{s}^{-1}$
(4) $1.3\ \mathrm{m}^2\ \mathrm{V}^{-1}\ \mathrm{s}^{-1}$

Q16. In the given circuit, an ideal voltmeter connected across the 10 Ω resistance reads 2 V . The internal resistance r , of each cell is:

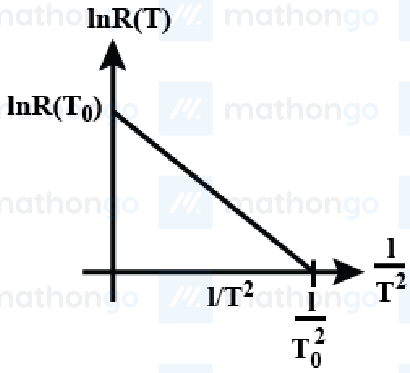


(1) 0 Ω
(2) 1.5 Ω
(3) 0.5 Ω
(4) 1 Ω

Q17. A moving coil galvanometer allows a full scale current of 10^{-4} A . A series resistance of $2 \times 10^4\ \Omega$ is required to convert the galvanometer into a voltmeter of range 0 − 5 V . Therefore, the value of shunt resistance required to convert the above galvanometer into an ammeter of range 0 − 10 mA is:

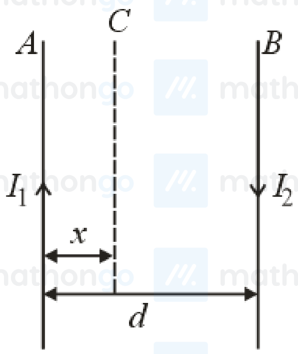
(1) $100\ \Omega$
(2) $200\ \Omega$
(3) $300\ \Omega$
(4) $10\ \Omega$

Q18. In an experiment, the resistance of a material is plotted as a function of temperature (in some range). As shown in the figure, it is a straight line.



One may conclude that
(1) $R(T)=R_0e^{T^2/T_0^2}$
(2) $R(T)=\frac{R_0}{T^2}$
(3) $R(T)=R_0e^{-T^2/T_0^2}$
(4) $R(T)=R_0e^{-T_0^2/T^2}$

Q19. Two wires A & B are carrying currents I_1 and I_2 as shown in the figure. The separation between them is d. A third wire C carrying a current I is to be kept parallel to them at a distance x from A such that the net force acting on it is zero. The possible values of x are:



(1) $x=\pm\frac{I_1 d}{(I_1-I_2)}$
(2) $x=\left(\frac{I_1}{I_1+I_2}\right)d$ and $x=\frac{I_2}{(I_1-I_2)}d$
(3) $x=\left(\frac{I_2}{I_1+I_2}\right)d$ and $x=\left(\frac{I_2}{I_1-I_2}\right)d$
(4) $x=\left(\frac{I_1}{I_1-I_2}\right)d$ and $x=\frac{I_2}{(I_1+I_2)}d$

Q20. A proton, an electron, and a Helium nucleus, have the same energy. They are in circular orbits in a plane due to magnetic field perpendicular to the plane. Let r_p, r_e and r_{He} be their respective radii, then,
(1) $r_e>r_p=r_{He}$
(2) $r_e<r_p=r_{He}$
(3) $r_e<r_p<r_{He}$
(4) $r_e>r_p>r_{He}$

Q21. A transformer consisting of 300 turns in the primary and 150 turns in the secondary gives output power of 2.2 kW. If the current in the secondary coil is 10 A, then the input voltage and current in the primary coil are:
(1) 440 V and 20 A
(2) 220 V and 20 A
(3) 440 V and 5 A
(4) 220 V and 10 A

Q22. Given below in the left column are different modes of communication using the kinds of waves given in the right column.

(1) Optical Fibre Communication	**(P) Ultrasound**
(2) Radar	(Q) Infrared Light
(3) Sonar	(R) Microwaves
(4) Mobile Phones	(S) Radio Waves

From the options given below, find the most appropriate match between entries in the left and the right column.

(1) $1-\mathrm{Q},\ 2-\mathrm{S},\ 3-\mathrm{P},\ 4-\mathrm{R}$
(2) $1-\ \mathrm{S},\ 2-\mathrm{Q},\ 3-\mathrm{R},\ 4-\mathrm{P}$
(3) $1-\mathrm{Q},\ 2-\mathrm{S},\ 3-\mathrm{R},\ 4-\mathrm{P}$
(4) $1-\mathrm{R},\ 2-\mathrm{P},\ 3-\mathrm{S},\ 4-\mathrm{Q}$

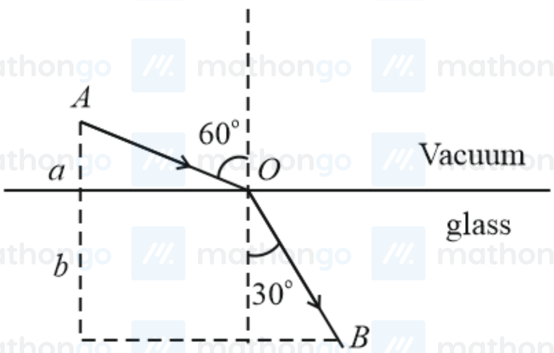
Q23. The electric field of a plane electromagnetic wave is given by

$\overrightarrow{\mathrm{E}}=\mathrm{E}_0\hat{i}\cos(\mathrm{k}z)\cos\left(\omega\mathrm{t}\right)$

The corresponding magnetic field $\overrightarrow{\mathrm{B}}$ is then given by:

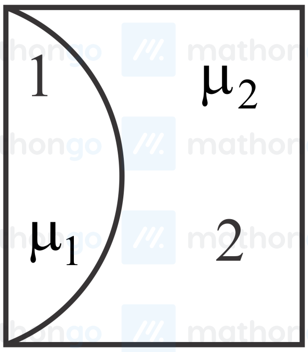
(1) $\overrightarrow{\mathrm{B}}=\frac{\mathrm{E}_0}{\mathrm{C}}\hat{j}\cos(\mathrm{k}z)\sin\left(\omega\mathrm{t}\right)$
(2) $\overrightarrow{\mathrm{B}}=\frac{\mathrm{E}_0}{\mathrm{C}}\widehat{k}\sin(\mathrm{k}z)\cos\left(\omega\mathrm{t}\right)$
(3) $\overrightarrow{\mathrm{B}}=\frac{\mathrm{E}_0}{\mathrm{C}}\hat{j}\sin(\mathrm{k}z)\sin\left(\omega\mathrm{t}\right)$
(4) $\overrightarrow{\mathrm{B}}=\frac{\mathrm{E}_0}{\mathrm{C}}\hat{j}\sin(\mathrm{k}z)\cos\left(\omega\mathrm{t}\right)$

Q24. A ray of light AO in vacuum is incident on a glass slab at angle 60° and refracted at angle 30° along OB as shown in the figure. The optical path length of light ray from A to B is:



(1) $\frac{2\sqrt{3}}{\mathrm{a}}+2\mathrm{b}$
(2) $2\mathrm{a}+2\mathrm{b}$
(3) $2\mathrm{a}+\frac{2\mathrm{b}}{\sqrt{3}}$
(4) $2\mathrm{a}+\frac{2\mathrm{b}}{3}$

Q25. One plano-convex and one plano-concave lens of the same radius of curvature R but of different materials are joined side by side as shown in the figure. If the refractive index of the material of 1 is μ_1 and that of 2 is μ_2, then the focal length of the combination is:



(1) $\frac{R}{2-(\mu_1-\mu_2)}$
(2) $\frac{R}{2(\mu_1-\mu_2)}$
(3) $\frac{2R}{\mu_1-\mu_2}$
(4) $\frac{R}{\mu_1-\mu_2}$

Q26. In a photoelectric effect experiment, the threshold wavelength of light is 380 nm . If the wavelength of incident light is 260 nm , the maximum kinetic energy of emitted electrons will be
Given E (in eV) $= \frac{1237}{\lambda(\text{in nm})}$

(1) 4.5 eV
(2) 3.0 eV
(3) 1.5 eV
(4) 15.1 eV

Q27. Two radioactive materials A and B have decay constants 10λ and λ, respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of A to that of B will be $1/e$ after a time:

(1) $\frac{1}{10\lambda}$
(2) $\frac{1}{9\lambda}$
(3) $\frac{1}{11\lambda}$
(4) $\frac{11}{10\lambda}$

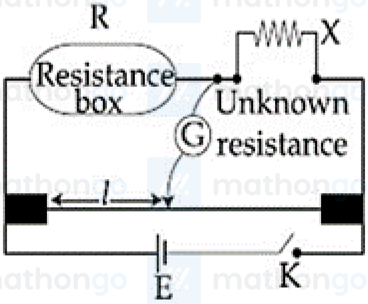
Q28. An NPN transistor operates as a common emitter amplifier, with a power gain of 60 dB . The input circuit resistance is $100\ \Omega$ and the output load resistance is $10\ k\Omega$. The common emitter current gain β is:

(1) 6×10^2
(2) 10^2
(3) 10^4
(4) 60

Q29. A message signal of frequency 100 MHz and peak voltage 100 V is used execute amplitude modulation on a carrier wave of frequency 300 GHz and peak voltage 400 V . The modulation index and difference between the two side band frequencies are:

(1) $4; 2 \times 10^8$ Hz
(2) $0.25; 2 \times 10^8$ Hz
(3) $4; 1 \times 10^8$ Hz
(4) $0.25; 1 \times 10^8$ Hz

Q30. In a meter bridge experiment, the circuit diagram and the corresponding observation table are shown in figure.

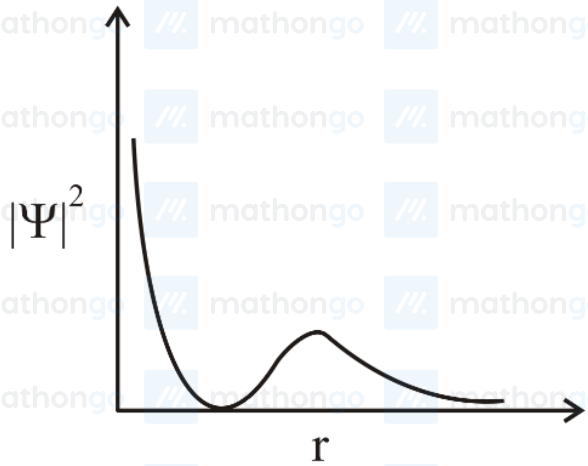


S. No.	$R(\Omega)$	l(cm)
1.	1000	60
2.	100	13
3.	10	1.5
4.	1	1.0

Which of the reading is inconsistent?
(1) 1
(2) 3
(3) 2
(4) 4

Q31. At 300 K and 1 atmospheric pressure, 10 mL of a hydrocarbon required 55 mL of O_2 for complete combustion, and 40 mL of CO_2 is formed. The formula of the hydrocarbon is:
(1) C_4H_8
(2) C_4H_{10}
(3) C_4H_6
(4) C_4H_7Cl

Q32. The graph between $|\psi|^2$ and r (radical distance) is shown below. This represents:



(1) 3s orbital
(2) 2p orbital
(3) 2s orbital
(4) 1s orbital

Q33. The isoelectronic set of ions is:
(1) F^-, Li^+, Na^+ and Mg^{2+}
(2) N^{3-}, Li^+, Mg^{2+} and O^{2-}
(3) N^{3-}, O^{2-}, F^- and Na^+
(4) Li^+, Na^+, O^{2-} and F^-

Q34. During the change of O_2 to O_2^-, the incoming electron goes to the orbital:
(1) $\pi\ 2p_x$
(2) $\pi^*\ 2p_x$
(3) $\pi\ 2p_y$
(4) $\sigma^*\ 2p_z$

Q35. Consider the following table:

Gas	$a/(\text{k Pa dm}^6\text{mol}^{-1})$	$b/(\text{dm}^3\text{mol}^{-1})$
A	642.32	0.05196
B	155.21	0.04136

Gas	$a/(k\,Pa\,dm^6 mol^{-1})$	$b/(dm^3 mol^{-1})$
C	431.91	0.05196
D	155.21	0.4382

a and b are vander Waals constants. The correct statement about the gases is:

(1) Gas C will occupy more volume than gas A ; gas B will be lesser compressible than gas D
(2) Gas C will occupy lesser volume than gas A ; gas B will be lesser compressible than gas D
(3) Gas C will occupy more volume than gas A ; gas B will be more compressible than gas D
(4) Gas C will occupy lesser volume than gas A ; gas B will be more compressible than gas D

Q36. A process will be spontaneous at all temperatures if:

(1) $\Delta H < 0$ and $\Delta S < 0$
(2) $\Delta H < 0$ and $\Delta S > 0$
(3) $\Delta H > 0$ and $\Delta S > 0$
(4) $\Delta H > 0$ and $\Delta S < 0$

Q37. Consider the following statements

(a) The pH of a mixture containing 400 mL of 0.1 M H_2SO_4 and 400 mL of 0.1 M NaOH will be approximately 1.3.
(b) Ionic product of water is temperature dependent.
(c) A monobasic acid with $K_a = 10^{-5}$ has a $pH = 5$. The degree of dissociation of this acid is 50% .
(d) The Le Chatelier's principle is not applicable to common-ion effect.

The correct statements are:

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

Q38. The synonym for water gas when used in the production of methanol is:

(1) syn gas
(2) laughing gas
(3) natural gas
(4) fuel gas

Q39. The alloy used in the construction of aircrafts is:

(1) $Mg - Al$
(2) $Mg - Mn$
(3) $Mg - Sn$
(4) $Mg - Zn$

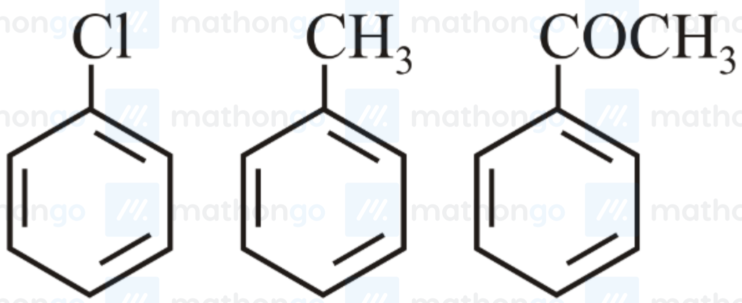
Q40. The correct order of catenation is:

(1) $Ge > Sn > Si > C$
(2) $C > Sn > Si \approx Ge$
(3) $C > Si > Ge \approx Sn$
(4) $Si > Sn > C > Ge$

Q41. The principle of column chromatography is:

(1) Differential adsorption of the substances on the solid phase.
(2) Differential absorption of the substances on the solid phase.
(3) Gravitational force.
(4) Capillary action

Q42. The increasing order of the reactivity of the following compounds towards electrophilic aromatic substitution reactions is:



(I) (II) (III)

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

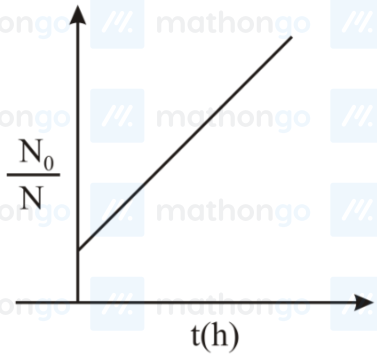
Q43. The regions of the atmosphere, where clouds form and where we live, respectively, are:
(1) Troposphere and Troposphere
(2) Stratosphere and Stratosphere
(3) Stratosphere and Troposphere
(4) Troposphere and Stratosphere

Q44. At room temperature, a dilute solution of urea is prepared by dissolving 0.60 g of urea in 360 g of water. If the vapour pressure of pure water at this temperature is 35 mm Hg , lowering of vapour pressure will be:
(molar mass of urea $= 60 \text{ g mol}^{-1}$)
(1) 0.028 mm Hg
(2) 0.027 mm Hg
(3) 0.031 mm Hg
(4) 0.017 mm Hg

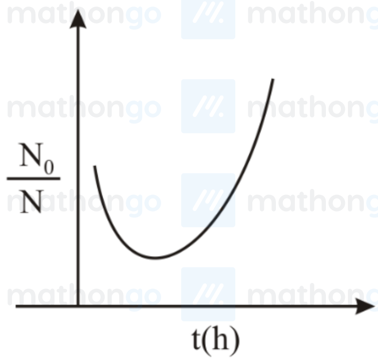
Q45. Consider the statements S1 and S2 :
S1 : Conductivity always increases with decreases in the concentration of electrolyte.
S2 : Molar conductivity always increases with decreases in the concentration of electrolyte.
The correct option among the following
(1) S1 is wrong and S2 is correct
(2) S1 is correct and S2 is wrong
(3) Both S1 and S2 are correct
(4) Both S1 and S2 are wrong

Q46. A bacterial infection in an internal wound grows as $N'(t) = N_0\exp(t)$, where the time t is in hours. A dose of antibiotic, taken orally, needs 1 hour to reach the wound. Once it reaches there, the bacterial population goes down as $\frac{dN}{dt} = -5N^2$. What will be the plot of $\frac{N_0}{N}$ vs t after 1 hour?

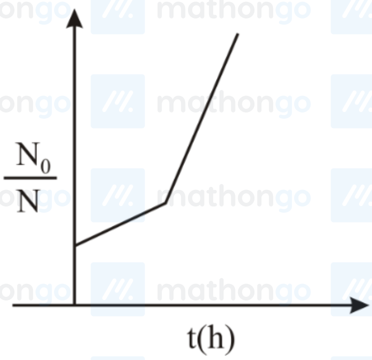
(1)



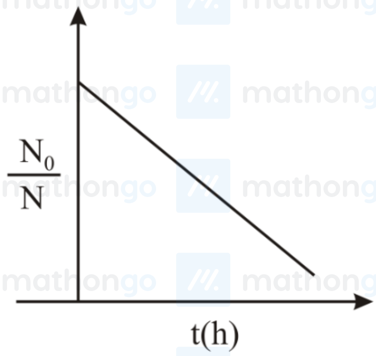
(2)



(3)



(4)



Q47. A gas undergoes physical adsorption on a surface and follows the given Freundlich adsorption isotherm equation

$\frac{x}{m} = kp^{0.5}$

Adsorption of the gas increases with:

(1) Decrease in p and increase in T
(2) Increase in p and decrease in T
(3) Increase in p and increase in T
(4) Decrease in p and decrease in T

Q48. Match the refining methods (Column I) with metals (Column II).

Column I	**Column II**	
(Refining methods)	(Metals)	
(I)	Liquation	(a) Zr
(II)	Zone Refining	(b) Ni
(III)	Mond Process	(c) Sn
(IV)	Van Arkel Method	(d) Ga

(1) (I) – (b); (II) – (c); (III) – (d); (IV) – (a)
(2) (I) – (b); (II) – (d); (III) – (a); (IV) – (c)
(3) (I) – (c); (II) – (d); (III) – (b); (IV) – (a)
(4) (I) – (c); (II) – (a); (III) – (b); (IV) – (d)

Q49. The oxoacid of sulphur that does not contain bond between sulphur atom is:

(1) $H_2S_2O_7$
(2) $H_2S_2O_4$
(3) $H_2S_4O_6$
(4) $H_2S_2O_3$

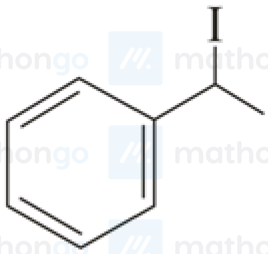
Q50. Consider the hydrated ions of Ti^{2+}, V^{2+}, Ti^{3+} and Sc^{3+} . The correct order of their spin-only magnetic moments is:

(1) $Sc^{3+} < Ti^{3+} < V^{2+} < Ti^{2+}$
(2) $Ti^{3+} < Ti^{2+} < Sc^{3+} < V^{2+}$
(3) $Sc^{3+} < Ti^{3+} < Ti^{2+} < V^{2+}$
(4) $V^{2+} < Ti^{2+} < Ti^{3+} < Sc^{3+}$

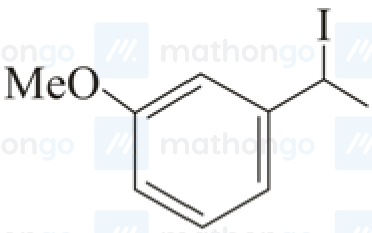
Q51. The species that can have a trans-isomer is:
$(\text{en} = \text{ethane} - 1, 2 - \text{diamine}, \text{ox} = \text{oxalate})$
(1) $[Cr(en)_2(ox)]^+$
(2) $[Pt(en)Cl_2]$
(3) $[Zn(en)Cl_2]$
(4) $[Pt(en)_2Cl_2]^{2+}$

Q52. Three complexes,
$[CoCl(NH_3)_5]^{2+}$(I), $[Co(NH_3)_5H_2O]^{3+}$(II) and $[Co(NH_3)_6]^{3+}$(III)
absorb light in the visible region. The correct order of the wavelength of light absorbed by them is:
(1) (II) > (I) > (III)
(2) (III) > (II) > (I)
(3) (I) > (II) > (III)
(4) (III) > (I) > (II)

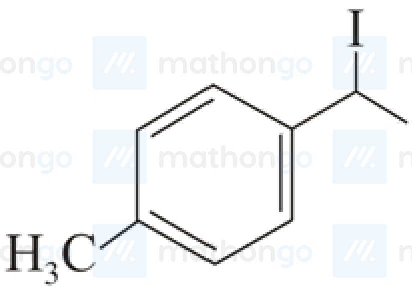
Q53. Increasing rate of S_N1 reaction in the following compounds is:



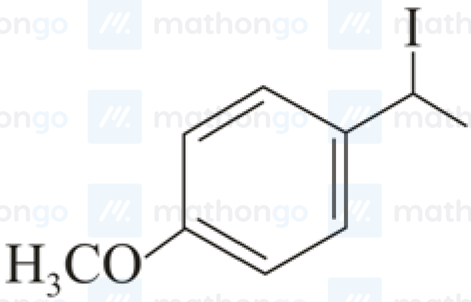
(I)



(II)



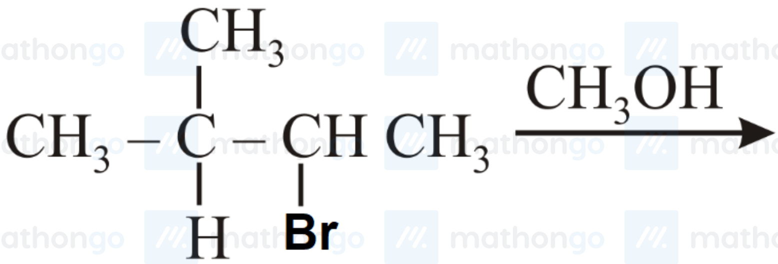
(III)

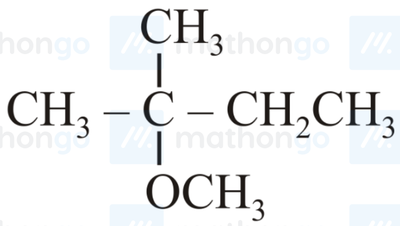


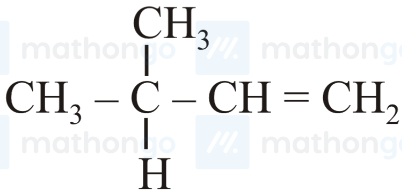
(IV)

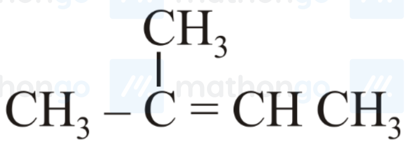
(1) (I) < (II) < (III) < (IV)
(2) (II) < (I) < (III) < (IV)
(3) (II) < (I) < (IV) < (III)
(4) (I) < (II) < (IV) < (III)

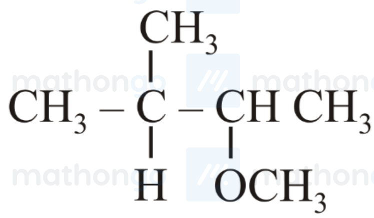
Q54. The major product of the following reaction is:



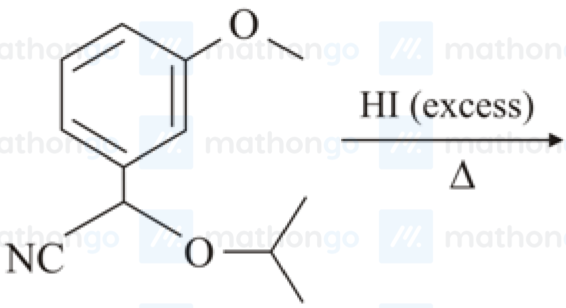
(1)


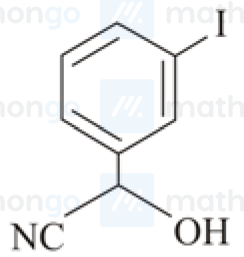
(2)


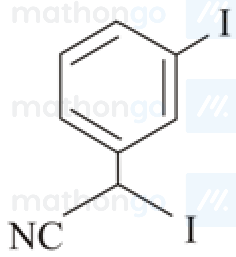
(3)


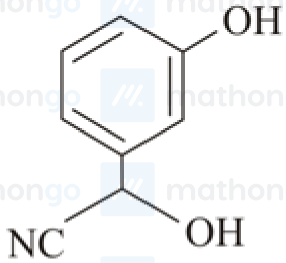
(4)


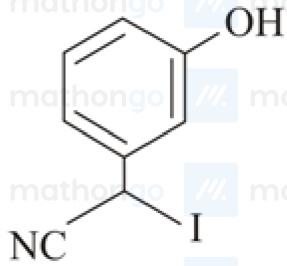
Q55. The major product of the following reaction is:



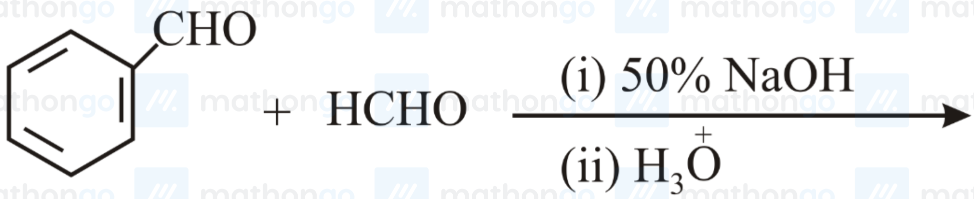
(1)


(2)


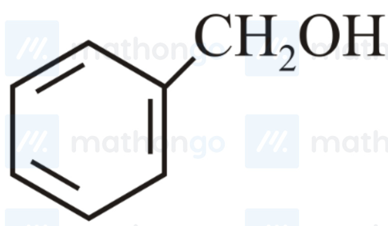
(3)


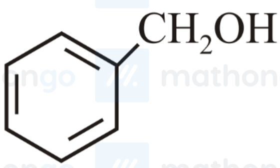
(4)


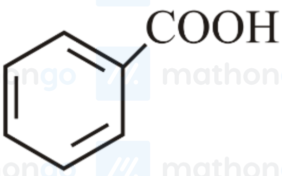
Q56. Major products of the following reaction are:

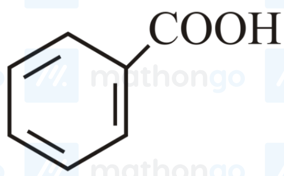


(1) CH_3OH and HCO_2H

(2) HCOOH and


(3)


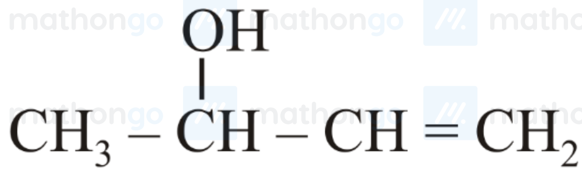
and


(4) CH_3OH and


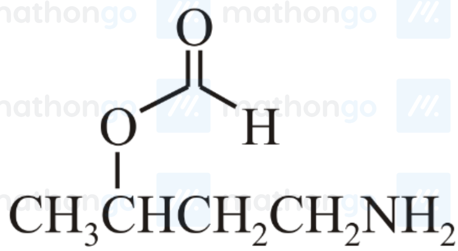
Q57. The major product of the following reaction is:

$$CH_3\underset{}{\overset{OH}{\overset{|}{C}}}HCH_2CH_2NH_2 \xrightarrow[\text{triethylamine}]{\text{ethyl formate (1 equiv.)}}$$

(1) 

(2) 

(3) $CH_3CH = CH - CH_2NH_2$

(4) 

Q58. Ethylamine $(C_2H_5NH_2)$ can be obtained from N-ethylphthalimide on treatment with:

(1) CaH_2

(2) NH_2NH_2

(3) H_2O

(4) $NaBH_4$

Q59. Which of the following is a condensation polymer?

(1) Nylon 6, 6

(2) Neoprene

(3) Buna−S

(4) Teflon

Q60. Amylopectin is composed of:

(1) $\beta - D-$ glucose, $C_1 - C_4$ and $C_1 - C_6$ linkages

(2) $\alpha - D-$ glucose, $C_1 - C_4$ and $C_2 - C_6$ linkages

(3) $\alpha - D-$ glucose, $C_1 - C_4$ and $C_1 - C_6$ linkages

(4) $\beta - D-$ glucose, $C_1 - C_4$ and $C_2 - C_6$ linkages

Q61. If α and β are the roots of the quadratic equation $x^2 + x\sin\theta - 2\sin\theta = 0,\ \theta \in \left(0, \frac{\pi}{2}\right)$, then $\frac{\alpha^{12}+\beta^{12}}{\left(\alpha^{-12}+\beta^{-12}\right).(\alpha-\beta)^{24}}$ is equal to :

(1) $\frac{2^6}{(\sin\theta+8)^{12}}$

(2) $\frac{2^{12}}{(\sin\theta-4)^{12}}$

(3) $\frac{2^{12}}{(\sin\theta+8)^{12}}$

(4) $\frac{2^{12}}{(\sin\theta-8)^{6}}$

Q62. If $a > 0$ and $z = \frac{(1+i)^2}{a-i}$, has magnitude $\sqrt{\frac{2}{5}}$, then $\bar{z}$ is equal to:

(1) $-\frac{1}{5} - \frac{3}{5}i$

(2) $-\frac{3}{5} - \frac{1}{5}i$

(3) $\frac{1}{5} - \frac{3}{5}i$

(4) $-\frac{1}{5} + \frac{3}{5}i$

Q63. The number of 6 digit number that can be formed using the digits 0, 1, 2, 5, 7 and 9 which are divisible by 11 and no digit is repeated is:

(1) 36

(2) 60

(3) 72

(4) 48

Q64. If $a_1, a_2, a_3 \ldots\ldots\ldots, a_n$ are in A. P. and $a_1 + a_4 + a_7 \ldots\ldots\ldots + a_{16} = 114$, then $a_1 + a_6 + a_{11} + a_{16}$ is equal to :

(1) 64

(2) 98

(3) 38

(4) 76

Q65. The sum $\frac{3\times1^3}{1^2}+\frac{5\times(1^3+2^3)}{1^2+2^2}+\frac{7\times(1^3+2^3+3^3)}{1^2+2^2+3^2}+\ldots.$ upto 10^{th} term is

(1) 660 (2) 600
(3) 620 (4) 680

Q66. If the coefficients of x^2 and x^3, are both zero, in the expansion of the expression $(1+ax+bx^2)(1-3x)^{15}$, in powers of x , then the ordered pair (a,b) is equal to

(1) $(28,315)$ (2) $(-21,714)$
(3) $(28,861)$ (4) $(-54,315)$

Q67. All the pairs $(x,\ y)$, that satisfy the inequality $2^{\sqrt{\sin^2x-2\sin x+5}}\cdot\frac{1}{4^{\sin^2y}}\leq1$ also satisfy the equation:

(1) $2\sin x=\sin y$ (2) $\sin x=2\sin y$
(3) $|\sin x|=|\sin y|$ (4) $2|\sin x|=3\sin y$

Q68. The line $x=y$ touches a circle at the point $(1,1)$. If the circle also passes through the point $(1,-3)$, then its radius is

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

Q69. If the circles $x^2+y^2+5Kx+2y+K=0$ and $2(x^2+y^2)+2Kx+3y-1=0$, $(K\in R)$, intersect at the points P and Q, then the line $4x+5y-K=0$, passes through P and Q, for:

(1) exactly two values of K (2) no value of K
(3) exactly one value of K (4) infinitely many values of K

Q70. If the line $x-2y=12$ is a tangent to the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ at the point $\left(3,-\frac{9}{2}\right)$, then the length of the latus rectum of the ellipse is

(1) 5 units (2) $12\sqrt{2}$ units
(3) 9 units (4) $8\sqrt{3}$ units

Q71. If a directrix of a hyperbola centered at the origin and passing through the point $\left(4,-2\sqrt{3}\right)$ is $5x=4\sqrt{5}$ and its eccentricity is e, then:

(1) $4e^4+8e^2-35=0$ (2) $4e^4-24e^2+35=0$
(3) $4e^4-24e^2+27=0$ (4) $4e^4-12e^2-27=0$

Q72. If $\lim\limits_{x\to1}\frac{x^4-1}{x-1}=\lim\limits_{x\to k}\frac{x^3-k^3}{x^2-k^2}$, then k is

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

Q73. Which one of the following Boolean expression is a tautology?

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

Q74. If for some $x\in$ R, the frequency distribution of the marks obtained by 20 students in a test is:

Marks	2	3	5	7
Frequency distribution	$(x+1)^2$	$(2x-5)$	x^2-3x	x

Then the mean of the marks is :

(1) 3.0
(2) 2.5
(3) 3.2
(4) 2.8

Q75. ABC is a triangular park with $AB = AC = 100$ metres. A vertical tower is situated at the mid-point of BC. If the angles of elevation of the top of the tower at, A and B are $\cot^{-1}\left(3\sqrt{2}\right)$ and $\operatorname{cosec}^{-1}\left(2\sqrt{2}\right)$ respectively, then the height of the tower (in metres) is

(1) $\frac{100}{3\sqrt{3}}$
(2) 20
(3) 25
(4) $10\sqrt{5}$

Q76. If the system of linear equations $x + y + z = 5,\ x + 2y + 2z = 6,\ \ x + 3y + \lambda z = \mu,\ (\lambda,\ \mu\ \in \mathrm{R})$, has infinitely many solutions, then the value of $\lambda + \mu$ is:

(1) 7
(2) 10
(3) 12
(4) 9

Q77.
If $\Delta_1 = \begin{vmatrix} x & \sin\theta & \cos\theta \\ -\sin\theta & -x & 1 \\ \cos\theta & 1 & x \end{vmatrix}$ and $\Delta_2 = \begin{vmatrix} x & \sin2\theta & \cos2\theta \\ -\sin2\theta & -x & 1 \\ \cos2\theta & 1 & x \end{vmatrix}$, $x \neq 0$; then for all $\theta \in \left(0,\ \frac{\pi}{2}\right)$:

(1) $\Delta_1 + \Delta_2 = -2\left(x^3 + x - 1\right)$
(2) $\Delta_1 - \Delta_2 = x(\cos2\theta - \cos4\theta)$
(3) $\Delta_1 + \Delta_2 = -2x^3$
(4) $\Delta_1 - \Delta_2 = -2x^3$

Q78. Let $f(x) = x^2,\ x \in R$. For any $A \subseteq R$, define $g(A) = \{x \in R\ : f(x) \in A\}$. If $S = [0,\ 4]$, then which one of the following statements is not true?

(1) $g(f(S)) \neq S$
(2) $f(g(S)) \neq f(S)$
(3) $f(g(S)) = S$
(4) $g(f(S)) = g(S)$

Q79. Let $f : R \to R$ be differentiable at $c \in R$ and $f(c) = 0$. If $g(x) = |f(x)|$, then at $x = c,\ g$ is:

(1) not differentiable
(2) not differentiable if $f'(c) = 0$
(3) differentiable if $f'(c) = 0$
(4) differentiable if $f'(c) \neq 0$

Q80.
If $f(x) = \begin{cases} \frac{\sin(p+1)x + \sin x}{x} & ,\ x < 0 \\ q & ,\ x = 0 \\ \frac{\sqrt{x + x^2} - \sqrt{x}}{x^{3/2}} & ,\ x > 0 \end{cases}$ is continuous at $x = 0$, then the ordered pair $(p,\ q)$ is equal to:

(1) $\left(-\frac{3}{2}, -\frac{1}{2}\right)$
(2) $\left(-\frac{1}{2}, \frac{3}{2}\right)$
(3) $\left(\frac{5}{2}, \frac{1}{2}\right)$
(4) $\left(-\frac{3}{2}, \frac{1}{2}\right)$

Q81. Let $f(x) = \mathrm{e}^{\mathrm{x}} - \mathrm{x}$ and $g(x) = \mathrm{x}^2 - \mathrm{x},\ \forall\ \mathrm{x} \in \mathrm{R}$. Then the set of all $\mathrm{x} \in \mathrm{R}$, where the function $h(x) = (fog)(x)$ is increasing, is:

(1) $\left[-1, -\frac{1}{2}\right] \bigcup \left[\frac{1}{2}, \infty\right)$
(2) $[0, \infty)$
(3) $\left[0, \frac{1}{2}\right] \cup \left[1, \infty\right)$
(4) $\left[-\frac{1}{2},\ 0\right] \cup \left[1, \infty\right)$

Q82. If $\int \frac{dx}{\left(x^2 - 2x + 10\right)^2} = A\left(\tan^{-1}\left(\frac{x-1}{3}\right) + \frac{f(x)}{x^2 - 2x + 10}\right) + C$, then (where C is a constant of integration)

(1) $A = \frac{1}{27}$ and $f(x) = 9(x - 1)$
(2) $A = \frac{1}{81}$ and $f(x) = 3(x - 1)$
(3) $A = \frac{1}{54}$ and $f(x) = 9(x - 1)^2$
(4) $A = \frac{1}{54}$ and $f(x) = 3(x - 1)$

Q83. The value of $\int_0^{2\pi}[\sin 2x(1+\cos 3x)]dx$, where $[t]$ denotes the greatest integer function is

(1) π
(2) 2π
(3) $-\pi$
(4) -2π

Q84. $\lim_{n\to\infty}\left(\frac{(n+1)^{1/3}}{n^{4/3}}+\frac{(n+2)^{1/3}}{n^{4/3}}+\ldots\ldots+\frac{(2n)^{1/3}}{n^{4/3}}\right)$ is equal to

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

Q85. The region represented by $|x-y|\le 2$ and $|x+y|\le 2$ is bounded by a

(1) rhombus of area $8\sqrt{2}$ sq. units.
(2) rhombus of side length 2 units.
(3) square of area 16 sq. units.
(4) square of side length $2\sqrt{2}$ units.

Q86. If $y=y(x)$ is the solution of the differential equation $\frac{dy}{dx}=\left(\tan x-y\right)\sec^2 x$, $x\in\left(-\frac{\pi}{2},\ \frac{\pi}{2}\right)$, such that $y(0)=0$, then $y\left(-\frac{\pi}{4}\right)$ is equal to:

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

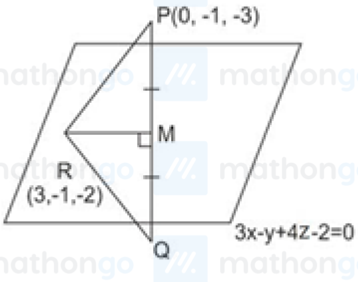
Q87. Let $A(3,0,-1),\ B(2,10,6)$ and $C(1,2,1)$ be the vertices of a triangle and M be the mid-point of AC. If G divides BM in the ratio, 2 : 1 , then $\cos(\angle GOA)$ (O being the origin) is equal to

(1) $\frac{1}{\sqrt{30}}$
(2) $\frac{1}{6\sqrt{10}}$
(3) $\frac{1}{\sqrt{15}}$
(4) $\frac{1}{2\sqrt{15}}$

Q88. If the length of the perpendicular from the point $(\beta,0,\beta),(\beta\neq 0)$ to the line, $\frac{x}{1}=\frac{y-1}{0}=\frac{z+1}{-1}$ is $\sqrt{\frac{3}{2}}$, then β is equal to

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

Q89. If Q$(0,-1,-3)$ is the image of the point P in the plane $3x-y+4z=2$ and R is the point $(3,-1,-2)$, then the area (in sq. units) of ΔPQR is



(1) $\frac{\sqrt{91}}{4}$
(2) $\frac{\sqrt{91}}{2}$
(3) $2\sqrt{13}$
(4) $\frac{\sqrt{65}}{2}$

Q90. Assume that each born child is equally likely to be a boy or girl. If two families have two children each, then the conditional probability that all children are girls given that at least two are girls is:

(1) $\frac{1}{12}$
(2) $\frac{1}{10}$
(3) $\frac{1}{11}$
(4) $\frac{1}{17}$

ANSWER KEYS

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