Q1. A particle is moving with speed $v = b\sqrt{x}$ along positive $x-$ axis. Calculate the speed of the particle at time $t = \tau$ (assume that the particle is at origin at $t = 0$)

(1) $b^2\tau$ (2) $\frac{b^2\tau}{\sqrt{2}}$

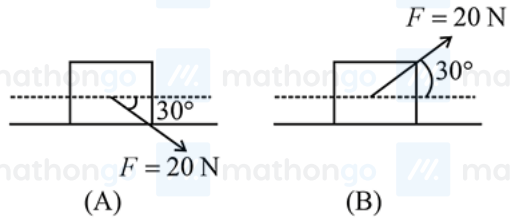
(3) $\frac{b^2\tau}{2}$ (4) $\frac{b^2\tau}{4}$

Q2. Two particles are projected from the same point with the same speed u such that they have the same range R, but different maximum heights, h_1 and h_2. Which of the following is correct?

(1) $R^2 = h_1h_2$ (2) $R^2 = 4\,h_1h_2$

(3) $R^2 = 2\,h_1h_2$ (4) $R^2 = 16\,h_1h_2$

Q3. A block of mass 5 kg is (i) pushed in case (A) and (ii) pulled in case (B), by a force $F = 20$ N, making an angle of 30^o with the horizontal, as shown in the figures. The coefficient of friction between the block and floor is $\mu = 0.2$. The difference between the accelerations of the block, in case (B) and case (A) will be:
$(g = 10\,m\,s^{-2})$



(1) $3.2\ m\ s^{-2}$ (2) $0\ m\ s^{-2}$

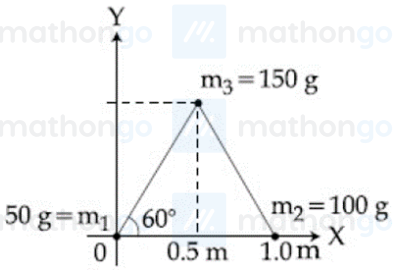
(3) $0.8\ m\ s^{-2}$ (4) $0.4\ m\ s^{-2}$

Q4. A spring whose unstrentches length is l has a force constant k. The spring is cut into two pieces of unstretches lengths l_1 and l_2 where, $l_1 = nl_2$ and n is an integer. The ratio k_1/k_2 of the corresponding force constants, k_1 and k_2 will be:

(1) $\frac{1}{n^2}$ (2) n^2

(3) n (4) $\frac{1}{n}$

Q5. Three particles of masses 50 g, 100 g and 150 g are placed at the vertices of an equilateral triangle of side 1 m (as shown in the figure). The (x, y) coordinates of the centre of mass will be:

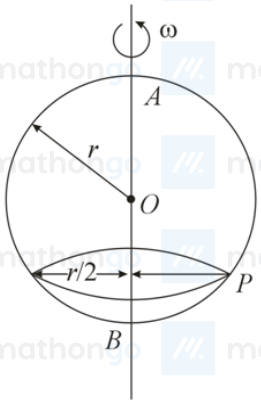


(1) $\left(\frac{7}{12}\ m, \frac{\sqrt{3}}{4}\ m\right)$ (2) $\left(\frac{7}{12}\ m, \frac{\sqrt{3}}{8}\ m\right)$

(3) $\left(\frac{\sqrt{3}}{4}\ m, \frac{5}{12}\ m\right)$ (4) $\left(\frac{\sqrt{3}}{8}\ m, \frac{7}{12}\ m\right)$

Q6. A smooth wire of length $2\pi r$ is bent into a circle and kept in a vertical plane. A bead can slide smoothly on the wire. When the circle is rotating with angular speed ω about the vertical diameter AB, as shown in figure, the

bead is at rest with respect to the circular ring at position P as shown. Then the value of ω^2 is equal to:



(1) $2g/r$ (2) $\frac{\sqrt{3}g}{2r}$
(3) $2g/\left(r\sqrt{3}\right)$ (4) $\left(g\sqrt{3}\right)/r$

Q7. The ratio of the weights of a body on Earth's surface to that on the surface of a planet is $9:4$ The mass of the planet is $\frac{1}{9}th$ of that of the Earth. If R is the radius of the Earth, what is the radius of the planet? (Take the planets to have the same mass density)

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

Q8. A solid sphere, of radius R acquires a terminal velocity v_1 when falling (due to gravity) through a viscous fluid having a coefficient of viscosity η. The sphere is broken into 27 identical solid spheres. If each of these spheres acquires a terminal velocity, v_2, when falling through the same fluid, the ratio $\left(\frac{v_1}{v_2}\right)$ equals:

(1) $\frac{1}{9}$ (2) 27
(3) $\frac{1}{27}$ (4) 9

Q9. A uniform cylindrical rod of length L and radius r, is made from a material whose Young's modulus of Elasticity equals Y. When this rod is heated by temperature T and simultaneously subjected to a net longutudinal compressional force F, its length remains unchanged. The coefficient of volume expansion, of the material of the rod, is (nearly) equal to:

(1) $F/\left(3\pi r^2 YT\right)$ (2) $9F/\left(\pi r^2 YT\right)$
(3) $6F/\left(\pi r^2 YT\right)$ (4) $3F/\left(\pi r^2 YT\right)$

Q10. 1 kg of water, at 20 $^\circ$C is heated in an electric kettle whose heating element has a mean (temperature averaged) resistance of 20 Ω. The rms voltage in the mains is 200 V. Ignoring heat loss from the kettle, time taken for water to evaporate fully is close to
[Specific heat of water $= 4200$ J kg^{-1} $^\circ$C^{-1} Latent heat of water $= 2260$ kJ kg^{-1}]

(1) 3 min (2) 16 min
(3) 22 min (4) 10 min

Q11. A Carnot engine has an efficiency of $\frac{1}{6}$. When the temperature of the sink is reduced by 62 °C , its efficiency is doubled. The temperatures of the source and the sink are, respectively,

(1) 124 °C, 62 °C (2) 37 °C, 99 °C
(3) 99 °C, 37 °C (4) 62 °C, 124 °C

Q12. A diatomic gas with rigid molecules does 10 J of work when expanded at constant pressure. What would be the heat energy absorbed by the gas, in this process?
(1) 40 J (2) 35 J
(3) 25 J (4) 30 J

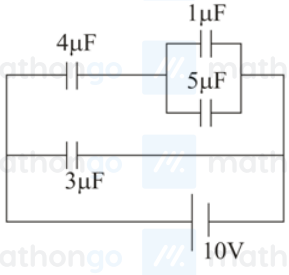
Q13. The number density of molecules of a gas depends on their distance r from the origin as, $n(r) = n_0 e^{-\alpha r^4}$. Then the numer of molecules is proportional to:
(1) $n_0\alpha^{-3}$ (2) $\sqrt{n_0}\alpha^{\frac{1}{2}}$
(3) $n_0\alpha^{\frac{-3}{4}}$ (4) $n_0\alpha^{\frac{1}{4}}$

Q14. A small speaker delivers 2 W of audio output. At what distance from the speaker will one detect 120 dB intensity sound? [Given reference intensity of sound as $10^{-12}\ \mathrm{W/m^2}$]
(1) 40 cm (2) 20 cm
(3) 10 cm (4) 30 cm

Q15. Two sources of sound S_1 and S_2 produce sound waves of same frequency 660 Hz. A listener is moving from source S_1 towards S_2 with a constant speed $\mathrm{u_0}$ m/s and he hears 10 beats/s. The velocity of sound is 330 m/s. Then, $\mathrm{u_0}$ equals:
(1) 10.0 m/s (2) 2.5 m/s
(3) 5.5 m/s (4) 15.0 m/s

Q16. Let a total charge 2Q be distributed in a sphere of radius R, with the charge density given by $\rho(\mathrm{r}) = \mathrm{kr}$, where r is the distance from the centre. Two charges A and B , of $-\mathrm{Q}$ each, are placed on diametrically opposite points, at equal distance, a, from the centre. If A and B do not experience any force, then:
(1) $\mathrm{a} = \frac{3\mathrm{R}}{2^{\frac{1}{4}}}$ (2) $\mathrm{a} = \frac{\mathrm{R}}{\sqrt{3}}$
(3) $\mathrm{a} = 2^{\frac{-1}{4}}\mathrm{R}$ (4) $\mathrm{a} = 8^{\frac{-1}{4}}\mathrm{R}$

Q17. In the given circuit, the charge on 4 μF capacitor will be:



(1) 9.6 μC (2) 5.4 μC
(3) 24 μC (4) 13.4 μC

Q18. A moving coil galvanometer, having a resistance G, produces full scale deflection when a current I_G flows through it. This galvanometer can be converted into (i) an ammeter of range 0 to $\mathrm{I_o}(\mathrm{I_0} > \mathrm{I_g})$ by connecting a shunt resistance $\mathrm{R_A}$ to it and (ii) into a voltmeter of range 0 to $\mathrm{V}(\mathrm{V} = \mathrm{GI_0})$ by connecting a series resistance $\mathrm{R_V}$ to it. Then,

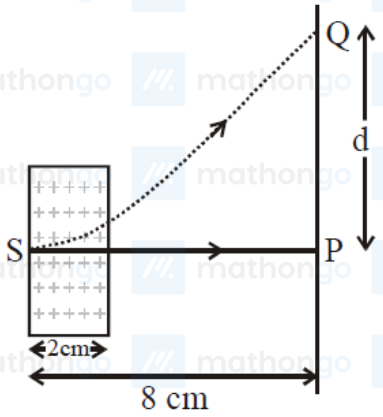
(1) $R_A R_V = G^2\left(\frac{I_0-I_g}{I_g}\right)$ and $\frac{R_A}{R_V} = \left(\frac{I_g}{(I_0-I_g)}\right)^2$

(2) $R_A R_V = G^2$ and $\frac{R_A}{R_V} = \frac{I_g}{(I_0-I_g)}$

(3) $R_A R_V = G^2\left(\frac{I_g}{I_0-I_g}\right)$ and $\frac{R_A}{R_V} = \left(\frac{I_0-I_g}{I_g}\right)^2$

(4) $R_A R_V = G^2$ and $\frac{R_A}{R_V} = \left(\frac{I_g}{I_0-I_g}\right)^2$

Q19. An electron, moving along the $x-$ axis with an initial energy of 100 eV, enters a region of magnetic field $\vec{B} = (1.5 \times 10^{-3}\ \text{T})\hat{k}$ at S (see figure). The field extends between $x = 0$ and $x = 2$ cm. The electron is detected at the point Q on a screen placed 8 cm away from the point S. The distance d between P and Q (on the screen) is:
(electron's charge 1.6×10^{-19} C , mass of electron $= 9.1 \times 10^{-31}$ kg)



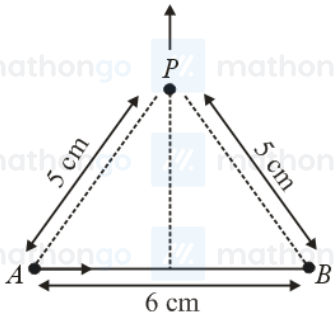
(1) 1.22 cm

(2) 12.87 cm

(3) 11.65 cm

(4) 2.25 cm

Q20. Find the magnetic field at point P due to a straight line segment AB of length 6 cm carrying a current of 5 A. (See figure) $(\mu_0 = 4\pi \times 10^{-7}\ \text{NA}^{-2})$



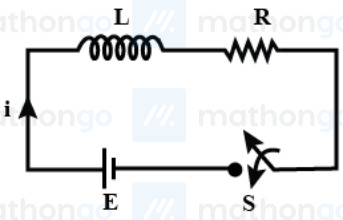
(1) 1.5×10^{-5} T

(2) 2.0×10^{-5} T

(3) 3.0×10^{-5} T

(4) 2.5×10^{-5} T

Q21. Consider the LR circuit shown in the figure. If the switch S is closed at $t = 0$ then the amount of charge that passes through the battery between $t = 0$ and $t = \frac{L}{R}$ is:

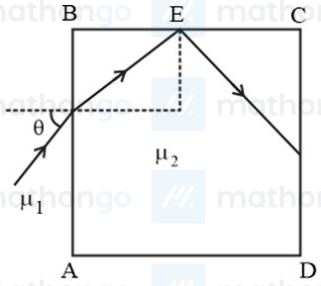


(1) $\frac{7.3\,EL}{R^2}$ (2) $\frac{EL}{7.3R^2}$
(3) $\frac{2.7\,EL}{R^2}$ (4) $\frac{EL}{2.7R^2}$

Q22. A plane electromagnetic wave having a frequency $f = 23.9\,\text{GHz}$ propagates along the positive $z-$ direction in free space. The peak value of the Electric Field is $60\ \text{V/m}$. Which among the following is the acceptable magnetic field component in the electromagnetic wave?

(1) $\overrightarrow{B} = 2\times10^{-7}\sin\left(0.5\times10^3 z - 1.5\times10^{11}t\right)\hat{i}$ (2) $\overrightarrow{B} = 2\times10^{-7}\sin\left(1.5\times10^3 x + 0.5\times10^{11}t\right)\hat{j}$
(3) $\overrightarrow{B} = 2\times10^{7}\sin\left(0.5\times10^3 z + 1.5\times10^{11}t\right)\hat{i}$ (4) $\overrightarrow{B} = 60\sin\left(0.5\times10^3 x + 1.5\times10^{11}t\right)\hat{i}$

Q23. A transparent cube of side d, made of a material of refractive index μ_2, is immersed in a liquid of refractive index μ_1 ($\mu_1 < \mu_2$). A ray is incident on the face AB at an angle θ (shown in the figure). Total internal reflection takes place at the point E on the face BC.



Then, θ must satisfy

(1) $\theta < \sin^{-1}\sqrt{\frac{\mu_2^2}{\mu_1^2} - 1}$ (2) $\theta > \sin^{-1}\frac{\mu_1}{\mu_2}$
(3) $\theta < \sin^{-1}\frac{\mu_1}{\mu_2}$ (4) $\theta > \sin^{-1}\sqrt{\frac{\mu_2^2}{\mu_1^2} - 1}$

Q24. A system of three polarizers $\mathrm{P_1, P_2, P_3}$ is set up such that the pass axis of $\mathrm{P_3}$ is crossed with respect to that of $\mathrm{P_1}$. The pass axis of $\mathrm{P_2}$ is inclined at 60° to the pass axis of $\mathrm{P_3}$. When a beam of unpolarized light of intensity $\mathrm{I_o}$ is incident on $\mathrm{P_1}$, the intensity of light transmitted by the three polarizers is I . The ratio $(\mathrm{I_o/I})$ equals (nearly):

(1) 5.33 (2) 16.00
(3) 1.80 (4) 10.67

Q25. Consider an electron in a hydrogen atom, revolving in its second excited state (having radius 4.65 Å). The de-Broglie wavelength of this electron is:

(1) 12.9 Å (2) 6.6 Å
(3) 9.7 Å (4) 3.5 Å

Q26. The electron in a hydrogen atom first jumps from the third excited state to the second excited state and subsequently to the first excited state. The ratio of the respective wavelengths $\frac{\lambda_1}{\lambda_2}$ of the photons emitted in this process is:

(1) $\frac{7}{5}$ (2) $\frac{20}{7}$

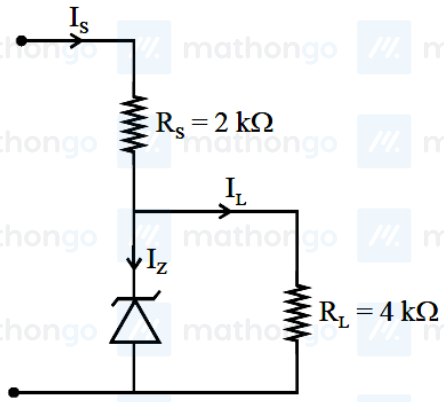
(3) $\frac{9}{7}$ (4) $\frac{27}{5}$

Q27. Half lives of two radioactive nuclei A and B are 10 minutes and 20 minutes, respectively. If, initially a sample has equal number of nuclei, then after 60 minutes, the ratio of decayed numbers of nuclei A and B will be:

(1) 3 : 8 (2) 8 : 1

(3) 1 : 8 (4) 9 : 8

Q28. Figure shows a DC voltage regulator circuit, with a Zener diode of breakdown voltage $= 6$ V . If the unregulated input voltage varies between 10 V to 16 V, then what is the maximum Zener current?



(1) 1.5 mA (2) 3.5 mA

(3) 7.5 mA (4) 2.5 mA

Q29. In a CE transistor amplifier, the audio signal voltage across the collector resistance of 2 kΩ is 2 V, if the base resistance is 1 kΩ and the current amplification of the transistor is 100 then the input signal voltage is

(1) 10 mV (2) 1 mV

(3) 0 .1 V (4) 1 V

Q30. A tunning fork of frequency 480 Hz is used in an experiment for measuring speed of sound (v) in air by resonance tube method. Resonance is observed to occur at two successive lengths of the air column, $l_1 = 30$ cm and $l_2 = 70$ cm. Then, ν is equal to:

(1) 384 m s^{-1} (2) 332 m s^{-1}

(3) 338 m s^{-1} (4) 379 m s^{-1}

Q31. 25 g of an unknown hydrocarbon upon burnig produces 88 g of CO_2 and 9g of H_2O. This unknown hydrocarbon contains:

(1) 24 g of carbon and 1 g of hydrogen (2) 18 g of carbon annd 7 g of hydrogen

(3) 22 g of carbon and 3 g of hydrogen (4) 20 g carbon and 5 g of hydrogen

Q32. Among the following, the energy of 2s orbital is lowest in:

(1) K (2) H
(3) Na (4) Li

Q33. In comparison to boron, berylium has:
(1) greater nuclear charge and lesser first ionisation enthalpy
(2) lesser nuclear charge and greater first ionisation enthalpy
(3) lesser nuclear charge and lesser first ionisation enthalpy.
(4) greater nuclear charge and greater first ionisation enthalpy.

Q34. The incorrect match in the following is:
(1) $\Delta G^0 < 0, K > 1$ (2) $\Delta G^0 > 0, K < 1$
(3) $\Delta G^0 = 0, K = 1$ (4) $\Delta G^0 < 0, K < 1$

Q35. In which one of the following equilibria, $K_p \neq K_c$?
(1) $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ (2) $2C(s) + O_2(g) \rightleftharpoons 2CO(g)$
(3) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$ (4) $NO_2(g) + SO_2(g) \rightleftharpoons NO(g) + SO_3(g)$

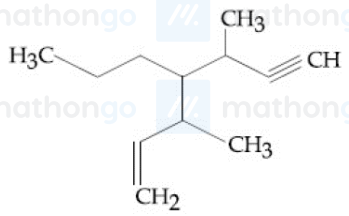
Q36. The molar solubility of $Cd(OH)_2$ is 1.84×10^{-5}M in water. The expectes solunility of $Cd(OH)_2$ in a buffer solution of pH = 12 is:
(1) 2.49×10^{-10}M (2) $\frac{2.49}{1.84} \times 10^{-9}$M
(3) 1.84×10^{-9}M (4) 6.23×10^{-11}M

Q37. The temporary hardness of a water sample is due to compound X. Boiling this sample converts X to compound Y. X and Y, respectively, are:
(1) $Mg(HCO_3)_2$ and $MgCO_3$ (2) $Ca(HCO_3)_2$ and $Ca(OH)_2$
(3) $Mg(HCO_3)_2$ and $Mg(OH)_2$ (4) $Ca(HCO_3)_2$ and CaO

Q38. The incorrect statement is:
(1) $LiNO_3$ decomposes on heating to give $LiNO_2$ and O_2. (2) LiCl crystallises from aqueous solution as $LiCl - 2H_2O$.
(3) Lithium is the strongest reducing agent among the alkali metals. (4) Lithium is least reactive with water among the alkali metals.

Q39. The C – C bond length is maximum in:
(1) C_{70} (2) C_{60}
(3) graphite (4) diamond

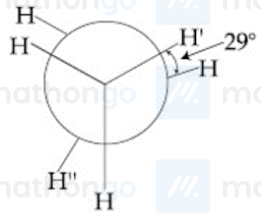
Q40. The IUPAC name for the following compound is:



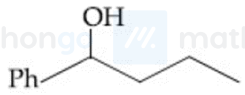
(1) 3−methyl−4−(1−methylprop−2−ynyl)−1−heptene
(2) 3, 5−dimethyl−4−propylhept−6−en−1−yne
(3) 3, 5−dimethyl−4−propyl hept−1−en−6−yne
(4) 3−methyl−4−(3−methylprop−1−enhyl)−1−heptyne

Q41. Which one of the following is likely to give a precipitate with $AgNO_3$ solution?
(1) $CH_2 = CH - Cl$ (2) $(CH_3)_3CCl$
(3) CCl_4 (4) $CHCl_3$

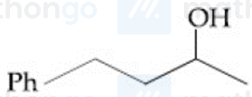
Q42. In the following skew conformation of ethane, $H' - C - C - H''$ dihedral angle is:

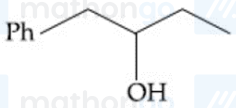


(1) 58° (2) 120°
(3) 149° (4) 151°

Q43. Heating of 2-chloro-1-phenylbutane with $EtOK/EtOH$ gives X as the major product. Reaction X with $Hg(OAc)_2/H_2O$ followed by $NaBH_4$ gives Y as the major product. Y is:
(1) 

(2) 

(3) 

(4) 

Q44. The primary pollutant that leads to photochemical smog is:
(1) nitrogen oxides (2) ozone
(3) acrolein (4) Sulphur dioxide

Q45. The ratio of number of atoms present in a simple cubic, body centered cubic and face centered cubic structure are, respectively :
(1) 4 : 2 : 1 (2) 1 : 2 : 4
(3) 4 : 2 : 3 (4) 8 : 1 : 6

Q46. A solution is prepared by dissolving 0.6 g of urea (molar mass = 60 g mol^{-1}) and 1.8 g of glucose (molar mass = 180 g mol^{-1}) in 100 mL of water at 27°C. The osmotic pressure of the solution is:
($R = 0.08206$ Latm K^{-1} mol^{-1})
(1) 8.2 atm (2) 2.46 atm
(3) 4.92 atm (4) 1.64 atm

Q47. The decreasing order of electrical conductivity of the following aqueous solutions is:
(A) 0.1 M Formic acid,

(B) 0.1 M Acetic acid,
(C) 0.1 M Benzoic acid.

(1) (A) > (B) > (C)
(2) (A) > (C) > (B)
(3) (C) > (B) > (A)
(4) (C) > (A) > (B)

Q48. NO_2 required for a reaction is produced by the decomposition of N_2O_5 in CCl_4 as per the equation, $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$.
The initial concentration of N_2O_5 is 3.00 mol L^{-1} and it is 2.75 mol L^{-1} after 30 minutes. The rate of formation of NO_2 is:

(1) 1.667×10^{-2} mol L^{-1} min^{-1}
(2) 8.333×10^{-3} mol $L^{-1}min^{-1}$
(3) 4.167×10^{-3} mol $L^{-1}min^{-1}$
(4) 2.083×10^{-3} mol L^{-1} min^{-1}

Q49. Among the following, the incorrect statement about colloids is:

(1) They are larger than small molecules and have high molar mass.
(2) They can scatter lighht.
(3) The osmotic pressure of a collodial solution is of higher order than the true solution at the same concentration.
(4) The range of diameters of colloidal particles is between 1 and 1000 nm.

Q50. The correct statement is:

(1) Pig iron is obtained from cast iron.
(2) The Hall-Heroult process is used for the production of aluminium and iron.
(3) leaching of bauxite using concentrated NaOH solution gives sodium aluminate and sodium silicate.
(4) the blistered appearance of copper during the metallurgical process is due to the evolution of CO_2.

Q51. The pair that has similar atomic radii is:

(1) Mo and W
(2) Sc and Ni
(3) Mn and Re
(4) Ti and Hf

Q52. Thermal decomposition of a Mn compound (X) at 513 K results in compound Y, MnO_2 and a gaseous product. MnO_2 reacts with NaCl and concentrated H_2SO_4 to give a pungent gasZ . X, Y and Z, respectively, are:

(1) K_3MnO_4, K_3MnO_4 and Cl_2
(2) K_2MnO_4, $KMnO_4$ and Cl_2
(3) $K_2MnO_4, KMnO_4$ and SO_2
(4) $KMnO_4$, K_2MnO_4 and Cl_2

Q53. The coordination numbers of Co and Al in $[Co(Cl)(en)_2]Cl$ and $K_3[Al(C_2O_4)_3]$, respectively are:
(en = ethane-1, 2-diamine)

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

Q54. The compound used in the treatment of lead poisoning is:

(1) Desferrioxime B
(2) EDTA
(3) Cis-platin
(4) D−penicillamine

Q55. An 'Assertion' and a 'Reason' is given below. Choose the correct answer from the following options:

Assertion (A): Vinyl halides do not undergo nucleophilic substitution easily.

Reason (R): Even though the intermediate carbocation is stabilized by loosely held $\pi-$ electrons, the cleavage is difficult because of the strong bonding.

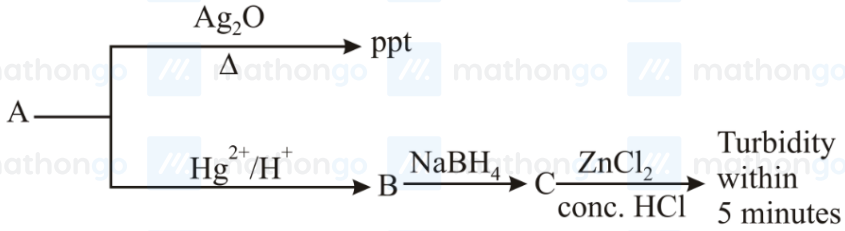
(1) Both (A) and (R) are correct statements but (R) is not the correct explanation of (A).

(2) Both (A) and (R) are wrong statements.

(3) Both (A) and (R) are wrong statements and (R) is the correct explanation of (A).

(4) (A) is a correct statement but (R) is a wrong statement.

Q56. Consider the following reactions:



'A' is:

(1) $CH_2 = CH_2$

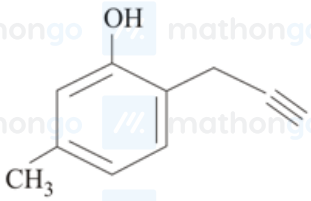
(2) $CH \equiv CH$

(3) $CH_3 - C \equiv C - CH_3$

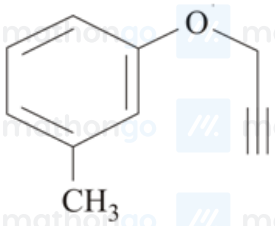
(4) $CH_3 - C \equiv CH$

Q57. What will be the major product when m-cresol is reacted with propargyl bromide $(HC \equiv C - CH_2Br)$ in presence of K_2CO_3 in acetone?

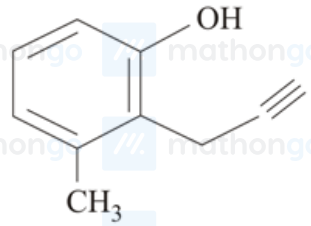
(1)



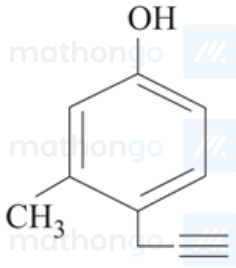
(2)



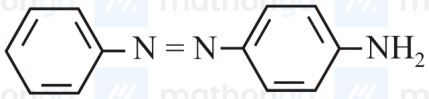
(3)

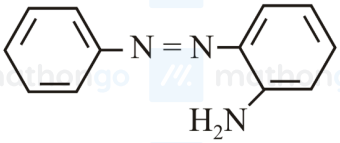


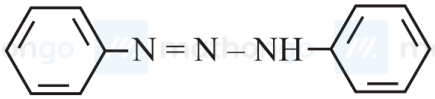
(4)

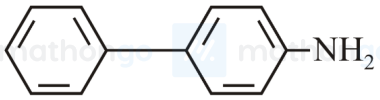


Q58. Benzene diazonium chloride on reaction with aniline in the presence of dilute hydrochloric acid gives:

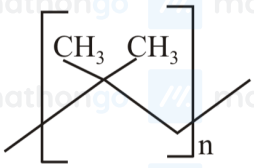
(1) 

(2) 

(3) 

(4) 

Q59. The correct name of the following polymer is:



(1) Polyisobutylene
(2) Polytert-butylene
(3) Polyisobutane
(4) Polyisoprene

Q60. Which of the given statements is incorrect about glycogen?
(1) It is present in animal cells.
(2) It is a straight chain polymer similar to amylose.
(3) It is present in some yeast and fungi
(4) Only α− linkages are present in the molecule.

Q61. If α, β and γ are three consecutive terms of a non-constant G.P. Such that the equations $\alpha x^2 + 2\beta x + \gamma = 0$ and $x^2 + x - 1 = 0$ have a common root, then $\alpha(\beta + \gamma)$ is equal to:
(1) $\beta\gamma$
(2) $\alpha\beta$
(3) $\alpha\gamma$
(4) 0

Q62. Let $z \in C$ with $\text{Im}(z) = 10$ and it satisfies $\frac{2z-n}{2z+n} = 2i - 1$ for some natural number n. Then
(1) $n = 20$ and $\text{Re}(z) = 10$
(2) $n = 40$ and $\text{Re}(z) = 10$
(3) $n = 20$ and $\text{Re}(z) = -10$
(4) $n = 40$ and $\text{Re}(z) = -10$

Q63. A group of students comprises of 5 boys and n girls. If the number of ways, in which a team of 3 students can randomly be selected from this group such that there is at least one boy and at least one girl in each team, is 1750, then n is equal to
(1) 24
(2) 27
(3) 25
(4) 28

Q64. If $a_1, a_2, a_3, \ldots$. are in A.P. such that $a_1 + a_7 + a_{16} = 40$, then the sum of the first 15 terms of this A.P is:
(1) 280
(2) 120
(3) 150
(4) 200

Q65. If ${}^{20}C_1 + (2^2)\ {}^{20}C_2 + (3^2)\ {}^{20}C_3 + \ldots\ldots + (20^2)\ {}^{20}C_{20} = A(2^\beta)$, then the ordered pair (A, β) is equal to

(1) $(380,\ 19)$ (2) $(420,\ 18)$
(3) $(420,\ 19)$ (4) $(380,\ 18)$

Q66. The term independent of x in the expansion of $\left(\frac{1}{60}-\frac{x^8}{81}\right).\left(2x^2-\frac{3}{x^2}\right)^6$ is equal to

(1) -72 (2) 36
(3) -108 (4) -36

Q67. Let S be the set of all $\alpha \in R$ such that the equation, $\cos 2x+\alpha \sin x=2\alpha-7$ has a solution. Then S is equal to:

(1) $[3,\ 7]$ (2) $[2,\ 6]$
(3) $[1,\ 4]$ (4) R

Q68. A triangle has a vertex at $(1,\ 2)$ and the mid points of the two sides through it are $(-1,\ 1)$ and $(2,\ 3)$. Then the centroid of this triangle is:

(1) $\left(\frac{1}{3},1\right)$ (2) $\left(1,\ \frac{7}{3}\right)$
(3) $\left(\frac{1}{3},\ 2\right)$ (4) $\left(\frac{1}{3},\ \frac{5}{3}\right)$

Q69. A straight line L at a distance of 4 units from the origin makes positive intercepts on the coordinate axes and the perpendicular from the origin to this line makes an angle of 60° with the line $x+y=0$. Then an equation of the line L is:

Note: In actual JEE Main paper, two options were correct for this question. Hence, we have changed one option.

(1) $\left(\sqrt{3}+1\right)x+\left(\sqrt{3}-1\right)y=8\sqrt{2}$ (2) $x+\sqrt{3}y=8$
(3) $\sqrt{3}x+y=8$ (4) $\left(\sqrt{3}-1\right)x+\sqrt{3}y=8\sqrt{2}$

Q70. A circle touching the $x-$ axis at $(3,\ 0)$ and making an intercept of length 8 on the $y-$ axis passes through the point:

(1) $(3,\ 10)$ (2) $(2,\ 3)$
(3) $(3,\ 5)$ (4) $(1,\ 5)$

Q71. The tangents to the curve $y=(x-2)^2-1$ at its points of intersection with the line $x-y=3$, intersect at the point:

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

Q72. An ellipse, with foci at $(0,2)$ and $(0,-2)$ and minor axis of length 4 , passes through which of the following points?

(1) $\left(1,\ 2\sqrt{2}\right)$ (2) $\left(2,\ \sqrt{2}\right)$
(3) $\left(\sqrt{2},\ 2\right)$ (4) $\left(2,\ 2\sqrt{2}\right)$

Q73. The equation of a common tangent to the curves, $y^2=16x$ and $xy=-4$, is:

(1) $x-2y+16=0$ (2) $x-y+4=0$
(3) $2x-y+2=0$ (4) $x+y+4=0$

Q74. $\lim\limits_{x\to 0}\frac{x+2\sin x}{\sqrt{x^2+2\sin x+1}-\sqrt{\sin^2 x-x+1}}$ is

(1) 3 (2) 1

(3) 2 (4) 6

Q75. The Boolean expression $\sim(p\Rightarrow(\sim q))$ is equivalent to

(1) $(\sim p)\Rightarrow q$ (2) $q\Rightarrow\sim p$

(3) $p\vee q$ (4) $p\wedge q$

Q76. The angle of the top of a vertical tower standing on a horizontal plane is observed to be 45° from a point A on the plane. Let B be the point 30 m vertically above the point A. If the angle of elevation of the top of the tower from B be 30° , then the distance (in m) of the foot of the tower from the point A is:

(1) $15\left(3+\sqrt{3}\right)$ (2) $15\left(1+\sqrt{3}\right)$

(3) $15\left(5-\sqrt{3}\right)$ (4) $15\left(3-\sqrt{3}\right)$

Q77. Let $A,\ B$ and C be sets such that $\phi\neq A\cap B\subseteq C$. Then which of the following statements is not true?

(1) $B\cap C\neq\phi$ (2) $(C\cup A)\cap(C\cup B)=C$

(3) If $(A-B)\subseteq C,$ then $A\subseteq C$ (4) If $(A-C)\subseteq B$, then $A\subseteq B$

Q78. A value of $\theta\in\left(0,\frac{\pi}{3}\right)$, for which $\begin{vmatrix}1+\cos^2\theta & \sin^2\theta & 4\cos 6\theta\\ \cos^2\theta & 1+\sin^2\theta & 4\cos 6\theta\\ \cos^2\theta & \sin^2\theta & 1+4\cos 6\theta\end{vmatrix}=0$, is

(1) $\frac{\pi}{9}$ (2) $\frac{7\pi}{24}$

(3) $\frac{7\pi}{36}$ (4) $\frac{\pi}{18}$

Q79. If $[x]$ denotes the greatest integer $\leq x$, then the system of linear equations $[\sin\theta]x+[-\cos\theta]y=0$, $[\cot\theta]x+y=0$

(1) has a unique solution if $\theta\in\left(\frac{\pi}{2},\frac{2\pi}{3}\right)\cup\left(\pi,\frac{7\pi}{6}\right)$ (2) have infinitely many solution if $\theta\in\left(\frac{\pi}{2},\frac{2\pi}{3}\right)\cup\left(\pi,\frac{7\pi}{6}\right)$

(3) has a unique if $\theta\in\left(\frac{\pi}{2},\frac{2\pi}{3}\right)$ and have infinitely many solutions if $\theta\in\left(\pi,\frac{7\pi}{6}\right)$ (4) have infinitely many solutions if $\theta\in\left(\frac{\pi}{2},\frac{2\pi}{3}\right)$ and has a unique solution if $\theta\in\left(\pi,\frac{7\pi}{6}\right)$

Q80. The derivative of $\tan^{-1}\left(\frac{\sin x-\cos x}{\sin x+\cos x}\right)$ with respect to $\frac{x}{2}$, where $x\in\left(0,\frac{\pi}{2}\right)$, is

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

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

Q81. Let $f(x)=5-|x-2|$ and $g(x)=|x+1|,\ x\in R$. If $f(x)$ attains maximum value at α and $g(x)$ attains minimum value at β, then $\lim\limits_{x\to-\alpha\beta}\frac{(x-1)(x^2-5x+6)}{x^2-6x+8}$ is equal to

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

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

Q82. Let $\alpha\in\left(0,\frac{\pi}{2}\right)$, be constant.If the integral $\int\frac{\tan x+\tan\alpha}{\tan x-\tan\alpha}dx=A(x)\cos 2\alpha+B(x)\sin 2\alpha+C$, where C is a constant of integration, then the functions $A(x)$ and $B(x)$ are respectively

(1) $x-\alpha$ and $\log_e|\sin(x-\alpha)|$ (2) $x+\alpha$ and $\log_e|\cos(x-\alpha)|$

(3) $x+\alpha$ and $\log_e|\sin(x+\alpha)|$ (4) $x-\alpha$ and $\log_e|\cos(x-\alpha)|$

Q83. A value of α such that $\int_{\alpha}^{\alpha+1} \frac{dx}{(x+\alpha)(x+\alpha+1)} = \log_e\left(\frac{9}{8}\right)$ is

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

Q84. If the area (in sq. units) bounded by the parabola $y^2 = 4\lambda x$ and the line $y = \lambda x$, $\lambda > 0$, is $\frac{1}{9}$, then λ is equal to

(1) $4\sqrt{3}$ (2) $2\sqrt{6}$
(3) 48 (4) 24

Q85. The general solution of the differential equation $\left(y^2 - x^3\right)dx - xydy = 0,\ (x \neq 0)$ is (where c is a constant of integration)

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

Q86. Let $\alpha \in R$ and the three vectors $\vec{a} = \alpha\hat{i} + \hat{j} + 3\hat{k},\ \vec{b} = 2\hat{i} + \hat{j} - \alpha\hat{k}$ and $\vec{c} = \alpha\hat{i} - 2\hat{j} + 3\hat{k}$. Then the set S = $\{\alpha : \vec{a}, \vec{b}$ and $\vec{c}$ are coplanar$\}$

(1) is singleton (2) contains exactly two positive numbers
(3) is empty (4) contains exactly two numbers only one of which is positive

Q87. A plane which bisects the angle between the two given planes $2x - y + 2z - 4 = 0$ and $x + 2y + 2z - 2 = 0$, passes through the point

(1) $(2,\ 4,\ 1)$ (2) $(1, -4,\ 1)$
(3) $(1,\ 4, -1)$ (4) $(2, -4,\ 1)$

Q88. The length of the perpendicular drawn from the point $(2,\ 1,\ 4)$ to the plane containing the lines $\vec{r} = \left(\hat{i} + \hat{j}\right) + \lambda\left(\hat{i} + 2\hat{j} - \hat{k}\right)$ and $\vec{r} = \left(\hat{i} + \hat{j}\right) + \mu\left(-\hat{i} + \hat{j} - 2\hat{k}\right)$ is

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

Q89. A person throws two fair dice. He wins Rs. 15 for throwing a doublet (same numbers on the two dice), wins Rs 12 when the throw results in the sum of 9 , and loses Rs. 6 for any other outcome on the throw. Then the expected gain/loss (in Rs.) of the person is:

(1) $\frac{1}{2}$ loss (2) $\frac{1}{2}$ gain
(3) 2 gain (4) $\frac{1}{4}$ loss

Q90. For an initial screening of an admission test, a candidate is given fifty problems to solve. If the probability that the candidate can solve any problem is $\frac{4}{5}$, then the probability that he is unable to solve less than two problems is

(1) $\frac{201}{5}\left(\frac{1}{5}\right)^{49}$ (2) $\frac{164}{25}\left(\frac{1}{5}\right)^{48}$
(3) $\frac{316}{25}\left(\frac{4}{5}\right)^{48}$ (4) $\frac{54}{5}\left(\frac{4}{5}\right)^{49}$

ANSWER KEYS

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