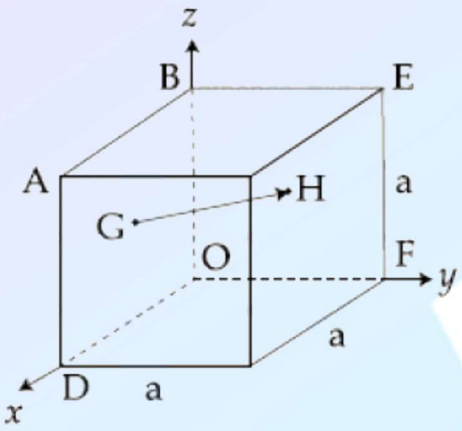
Q1. In the cube of side 'a' shown in the figure, the vector from the central point of the face $ABOD$ to the central point of the face $BEFO$ will be:

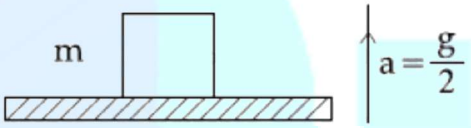


(1) $\frac{1}{2}a(\hat{k}-\hat{\imath})$
(2) $\frac{1}{2}a(\hat{\imath}-\hat{k})$
(3) $\frac{1}{2}a(\hat{\jmath}-\hat{\imath})$
(4) $\frac{1}{2}a(\hat{\jmath}-\hat{k})$

Q2. The density of a material in SI units is $128\ \text{kg m}^{-3}$. In certain units in which the unit of length is 25 cm and the unit of mass is 50 g , the numerical value of density of the material is:
(1) 410
(2) 16
(3) 40
(4) 640

Q3. Two guns A and B can fire bullets at speeds $1\ \text{km/s}$ and $2\ \text{km/s}$ respectively. From a point on a horizontal ground, they are fired in all possible directions. The ratio of maximum areas covered by the bullets fired by the two guns, on the ground is:
(1) $1:16$
(2) $1:2$
(3) $1:4$
(4) $1:8$

Q4. A block of mass m is kept on a platform which starts from rest with a constant acceleration $g/2$ upwards, as shown in the figure. Work done by normal reaction on block in time t is



(1) $-\frac{mg^2t^2}{8}$
(2) $\frac{mg^2t^2}{8}$
(3) 0
(4) $\frac{3mg^2t^2}{8}$

Q5. A piece of wood of mass 0.03 kg is dropped from the top of a 100 m height building. At the same time, a bullet of mass 0.02 kg is fired vertically upward, with a velocity $100\ \text{ms}^{-1}$, from the ground. The bullet gets embedded in the wood. Then the maximum height to which the combined system reaches above the top of the building before falling below is: $(g = 10\ \text{ms}^{-2})$
(1) 40 m
(2) 20 m
(3) 10 m
(4) 30 m

Q6. To mop-clean a floor, a cleaning machine presses a circular mop of radius R vertically down with a total force F and rotates it with a constant angular speed about its axis. If the force F is distributed uniformly over the mop and if coefficient of friction between the mop and the floor is μ, the torque, applied by the machine on the mop is:
(1) $2\mu FR/3$
(2) $\mu FR/3$
(3) $\mu FR/6$
(4) $\mu FR/2$

Q7. A homogeneous solid cylindrical roller of radius R and mass M is pulled on a cricket pitch by a horizontal force. Assuming rolling without slipping, angular acceleration of the cylinder is:
(1) $\frac{F}{3mR}$
(2) $\frac{3F}{2mR}$

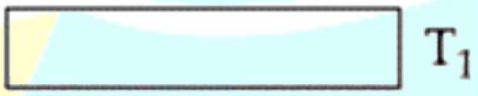
(3) $\frac{2F}{3mR}$
(4) $\frac{F}{2mR}$

Q8. A satellite is moving with a constant speed v in circular orbit around the earth. An object of mass ' m ' is ejected from the satellite such that it just escapes from the gravitational pull of the earth. At the time of ejection, the kinetic energy of the object is:
(1) $\frac{3}{2}mv^2$
(2) mv^2
(3) $\frac{1}{2}mv^2$
(4) $2mv^2$

Q9. Water flows into a large tank with flat bottom at the rate of 10^{-4} m^3 s^{-1}. Water is also leaking out of a hole of area 1 cm^2 at its bottom. If the height of the water in the tank remains steady then this height is:
(1) 5.1 cm
(2) 1.7 cm
(3) 2.9 cm
(4) 4 cm

Q10. A heat source at $T = 10^3$ K is connected to another heat reservoir at $T = 10^2$ K by a copper slab which is 1 m thick. Given that the thermal conductivity of copper is 0.1 W K^{-1} m^{-1}, the energy flux through it in the steady-state is:
(1) 65 W m^{-2}
(2) 120 W m^{-2}
(3) 90 W m^{-2}
(4) 200 W m^{-2}

Q11. Three Carnot engines operate in series between a heat source at a temperature T_1 and a heat sink at temperature T_4 (see figure). There are two other reservoirs at temperature T_2 and T_3, as shown, with
$T_1 > T_2 > T_3 > T_4$. The three engines are equally efficient if:



ε_1

T_2
ε_2

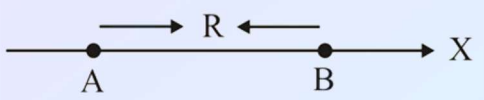
ε_3

(1) $T_2 = (T_1T_4^2)^{\frac{1}{3}}; T_3 = (T_1^2T_4)^{\frac{1}{3}}$
(2) $T_2 = (T_1T_4)^{\frac{1}{2}}; T_3 = (T_1^2T_4)^{\frac{1}{3}}$
(3) $T_2 = (T_1^2T_4)^{\frac{1}{3}}; T_3 = (T_1T_4^2)^{\frac{1}{3}}$
(4) $T_2 = (T_1^3T_4)^{\frac{1}{4}}; T_3 = (T_1T_4^3)^{\frac{1}{3}}$

Q12. A train moves towards a stationary observer with speed 34 m/s. The train sounds a whistle and its frequency registered by the observer is f_1. If the speed of the train is reduced to 17 m/s, the frequency registered is f_2. If speed of sound is 340 m/s, then the ratio f_1/f_2 is:
(1) 21/20
(2) 20/19
(3) 19/18
(4) 18/17

Q13. A string of length 1 m and mass 5 g is fixed at both ends. The tension in the string is 8.0 N . The string is set into vibration using an external vibrator of frequency 100 Hz . The separation between successive nodes on the string is close to
(1) 20.0 cm
(2) 10.0 cm
(3) 16.6 cm
(4) 33.3 cm

Q14. Two electric dipoles, A, B with respective dipole moments $\overrightarrow{d_A} = -4qa\hat{i}$ and $\overrightarrow{d_B} = -2qa\hat{i}$ are placed on the x axis with a separation R, as shown in the figure



The distance from A at which both of them produce the same potential is:

(1) $\frac{R}{\sqrt{2}-1}$

(2) $\frac{\sqrt{2}R}{\sqrt{2}-1}$

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

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

Q15. A charge Q is distributed over three concentric spherical shells of radii $a, b, c (a < b < c)$ such that their surface charge densities are equal to one another.
The total potential at a point at distance r from their common centre, where $r < a$, would be:

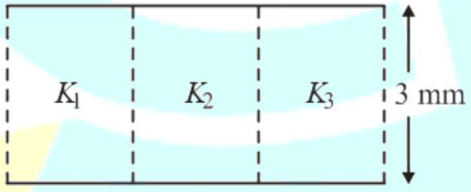
(1) $\frac{Q}{4\pi\epsilon_0(a+b+c)}$

(2) $\frac{Q(a^2+b^2+c^2)}{4\pi\epsilon_0(a^3+b^3+c^3)}$

(3) $\frac{Q}{12\pi\epsilon_0}\frac{ab+bc+ca}{abc}$

(4) $\frac{Q(a+b+c)}{4\pi\epsilon_0(a^2+b^2+c^2)}$

Q16. A parallel plate capacitor is of area 6 cm^2 and a separation 3 mm . The gap is filled with three dielectric materials of equal thickness (see figure) with dielectric constant $K_1 = 10, K_2 = 12$ and $K_3 = 14$. The dielectric constant of a material which when fully inserted in above capacitor, gives same capacitance would be:



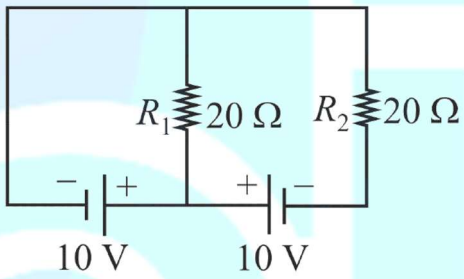
(1) 4

(2) 36

(3) 14

(4) 12

Q17. In the given circuit the cells have zero internal resistance. The currents (in amperes) passing through resistance R_1 and R_2 respectively, are:



(1) 0,1

(2) 2,2

(3) 0.5,0

(4) 1,2

Q18. A uniform metallic wire has a resistance of 18Ω and is bent into an equilateral triangle. Then, the resistance between any two vertices of the triangle is:

(1) 2Ω

(2) 12Ω

(3) 8Ω

(4) 4Ω

Q19. A 2 W carbon resistor is color coded with green, black, red and silver respectively. The maximum current which can be passed through this resistor is:

(1) 100 mA

(2) 0.4 mA

(3) 20 mA

(4) 63 mA

Q20. A magnet of total magnetic moment $10^{-2}\hat{i}Am^2$ is placed in a time varying magnetic field, $B\hat{i}(\cos\omega t)$ where $B = 1$ Tesla and $\omega = 0.125 rads^{-1}$. The work done for reversing the direction of the magnetic moment at $t = 1$ second, is:

(1) 0.007 J

(2) 0.02 J

(3) 0.014 J
(4) 0.01 J

Q21. An insulating thin rod of length l has a linear charge density $\rho(x) = \rho_0 \frac{x}{l}$ on it. The rod is rotated about an axis passing through the origin $(x = 0)$ and perpendicular to the rod. If the rod makes n rotations per second, then the time averaged magnetic moment of the rod is:
(1) $\frac{\pi}{4} n\rho_0 l^3$
(2) $n\rho_0 l^3$
(3) $\pi n\rho_0 l^3$
(4) $\frac{\pi}{3} n\rho_0 l^3$

Q22. A solid metal cube of edge length 2 cm is moving in the positive y-direction, at a constant speed of 6 m s^{-1}. There is a uniform magnetic field of 0.1 T in the positive z -direction. The potential difference between the two faces of the cube, perpendicular to the x -axis, is
(1) 12 mV
(2) 1 mV
(3) 2 mV
(4) 6 mV

Q23. If the magnetic field of a plane electromagnetic wave is given by (The speed of light $= 3 \times 10^8$ m/s) $B = 100 \times 10^{-6} \sin\left[2\pi \times 2 \times 10^{15}\left(t - \frac{x}{c}\right)\right]$ then the maximum electric field associated with it is:
(1) 3×10^4 NC^{-1}
(2) 4×10^4 NC^{-1}
(3) 4.5×10^4 NC^{-1}
(4) 6×10^4 NC^{-1}

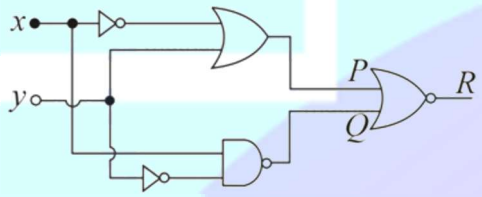
Q24. A plano-convex lens of refractive index μ_1 and focal length f_1 is kept in contact with another plano-concave lens of refractive index μ_2 and focal length f_2. If the radius of curvature of their spherical faces is R each and $f_1 = 2f_2$, the μ_1 and μ_2 are related as:
(1) $2\mu_2 - \mu_1 = 1$
(2) $3\mu_2 - 2\mu_1 = 1$
(3) $\mu_1 + \mu_2 = 3$
(4) $2\mu_1 - \mu_2 = 1$

Q25. In a Young's double slit experiment slit separation 0.1 mm , one observes a bright fringe at angle $\frac{1}{40}$ rad by using light of wavelength λ_1. When the light of wavelength λ_2 is used a bright fringe is seen at the same angle in the same set up. Given that λ_1 and λ_2 are in visible range (380 nm to 740 nm), their values are:
(1) 400 nm, 500 nm
(2) 380 nm, 525 nm
(3) 625 nm, 500 nm
(4) 380 nm, 500 nm

Q26. In an electron microscope, the resolution that can be achieved is of the order of the wavelength of electrons used. To resolve a width of 7.5×10^{-12} m, the minimum electron energy required is close to:
(1) 100 keV
(2) 25 keV
(3) 1 keV
(4) 500 keV

Q27. Using a nuclear counter the count rate of emitted particles from a radioactive source is measured. At $t = 0$ it was 1600 counts per second and $t = 8$ seconds it was 100 counts per second. The count rate observed, as counts per second, at $t = 6$ seconds is close to:
(1) 400
(2) 200
(3) 150
(4) 360

Q28. To get output '1' at R, for the given logic gate circuit the input values must be:

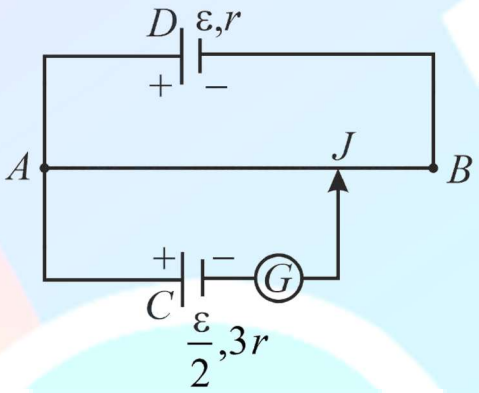


(1) $X = 1, Y = 1$
(2) $X = 0, Y = 0$
(3) $X = 0, Y = 1$
(4) $X = 1, Y = 0$

Q29. A TV transmission tower has a height of 140 m and the height of the receiving antenna is 40 m . What is the maximum distance upto which signals can be broadcasted from this tower

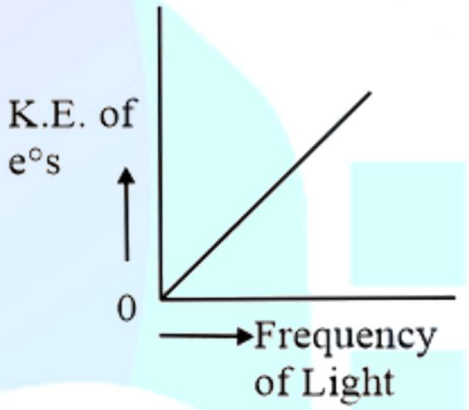
in LOS (Line of Sight) mode? (Given: radius of earth = 6.4×10^6 m).
(1) 48 km
(2) 40 km
(3) 80 km
(4) 65 km

Q30. A potentiometer wire AB having length L and resistance $12r$ is joined to a cell D of emf ε and internal resistance r. A cell C having EMF $\varepsilon/2$ and internal resistance $3r$ is connected. The length AJ, at which the galvanometer, as shown in the figure, shows no deflection is

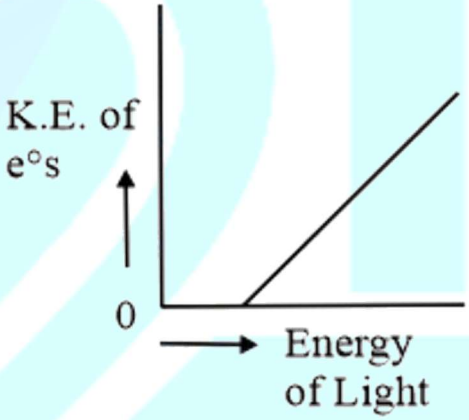


(1) $\frac{5}{12}L$
(2) $\frac{11}{24}L$
(3) $\frac{11}{12}L$
(4) $\frac{13}{24}L$

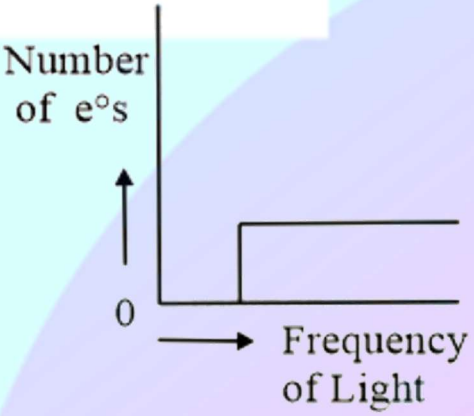
Q31. Which of the graphs shown below does not represent the relationship between incident light and the electron ejected from metal surface?
(1)



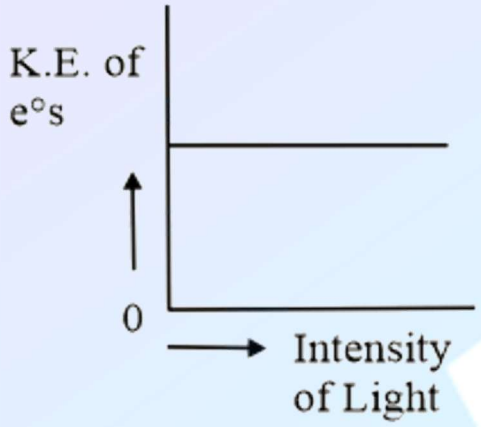
(2)



(3)



(4)



Q32. The type of hybridization and no. of lone pair(s) of electron of Xe in $XeOF_4$, respectively, are:
(1) sp^3d^2 and 1
(2) sp^3d^2 and 2
(3) sp^3d and 2
(4) sp^3d and 1

Q33. Two pi and half sigma bonds are present in:
(1) O_2^-
(2) N_2^+
(3) N_2
(4) O_2

Q34. A process has $\Delta H = 200 \text{Jmol}^{-1}$ and $\Delta S = 40 \text{JK}^{-1}\ \text{mol}^{-1}$. Out of the values given below choose the minimum temperature above which the process will be spontaneous:
(1) $20K$
(2) 5 K
(3) 12 K
(4) $4K$

Q35. What are the values of $\frac{K_p}{K_c}$ for the following reactions at 300 K respectively?
(At 300 K, $RT = 24.62 \text{dm}^2\ \text{atm mol}^{-1}$)
$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$
$N_2O_4(g) \rightleftharpoons 2NO(g)$
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
(1) $24.63 \text{dm}^3\ \text{atm mol}^{-1}$,
$606.0 \text{dm}^6\ \text{atm}^2\ \text{mol}^{-2}$,
(2) $1,24.62 \text{dm}^6\ \text{atm}^3\ \text{mol}^{-1}$
$606.0 \text{dm}^6\ \text{atm}^2\ \text{mol}^{-2}$
$1.65 \times 10^{-3} \text{dm}^{-6}\ \text{atm}^{-2}\ \text{mol}^2$
(3) $1,24.62 \text{dm}^3\ \text{atm mol}^{-1}$
$1.65 \times 10^{-3} \text{dm}^{-6}\ \text{atm}^{-2}\ \text{mol}^2$
(4) $1,4.1 \times 10^{-2} \text{dm}^{-3}\ \text{atm}^{-1}$ mol,
$606 \text{dm}^6\ \text{atm}^2\ \text{mol}^{-2}$

Q36. A mixture of 100 m mol of $Ca(OH)_2$ and 2 g of sodium sulphate was dissolved in water and the volume was made up to 100 mL . What is the mass of calcium sulphate formed and the concentration of OH^- in resulting solution, respectively? (Molar mass of $Ca(OH)_2$, Na_2SO_4 and $CaSO_4$ are 74,143 and 136 g mol^{-1}, respectively; K_{sp} of $Ca(OH)_2$ is 5.5×10^{-6})
(1) 1.9 g, 0.14 mol L^{-1}
(2) 13.6 g, 0.28 mol L^{-1}
(3) 1.9 g, 0.28 mol L^{-1}
(4) 13.6 g, 0.14 mol L^{-1}

Q37. The chemical nature of hydrogen peroxide is:
(1) Oxidizing and reducing agent in both acidic and basic medium.
(2) Oxidizing agent in acidic medium, but not in basic medium
(3) Oxidizing and reducing agent in acidic medium, but not in basic medium
(4) Reducing agent in basic medium, but not in acidic medium.

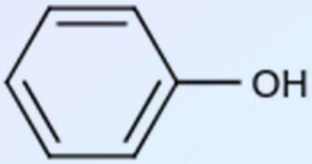
Q38. The total number of isotopes of hydrogen and number of radioactive isotopes among them, respectively, are
(1) 2 and 1
(2) 2 and 0
(3) 3 and 1
(4) 3 and 2

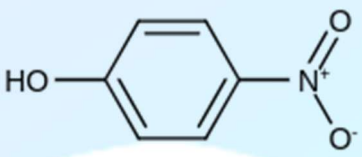
Q39. The metal used for making X-ray tube window is:
(1) Mg
(2) Na
(3) Be
(4) Ca

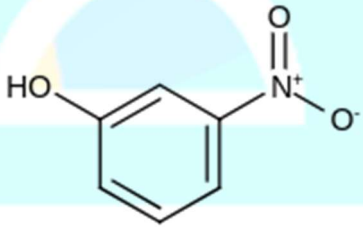
Q40. The electronegativity of aluminum is similar to:
(1) Beryllium
(2) Boron

(3) Carbon
(4) Lithium

Q41. The increasing order of the pKa values of the following compounds is:





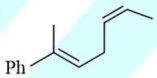


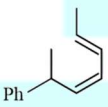
A
B
C
D

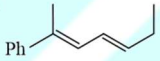
(1) $B < C < A < D$
(2) $D < A < C < B$
(3) $B < C < D < A$
(4) $C < B < A < D$

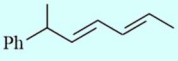
Q42.If Dichloromethane (DCM) and water H_2O are used for differential extraction, which one of the following statements is correct?
(1) DCM and H_2O would stay as upper and lower
(2) DCM and H_2O will be miscible clearly layer respectively in the separating funnel (S.F.)
(3) DCM and H_2O would stay as lower and upper layer respectively in the S.F
(4) DCM and H_2O will make turbid/colloidal mixture

Q43. The major product of the following reaction is:

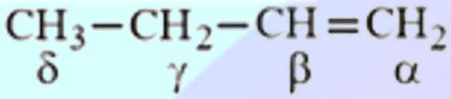
(1)


(2)


(3)


(4)


Q44. Which hydrogen in compound (E) is easily replaceable during bromination reaction in presence of light ?



(E)

(1) β-hydrogen
(2) δ-hydrogen
(3) α-hydrogen
(4) γ - hydrogen

Q45. Water filled in two glasses A and B gave BOD values of 10 and 20, respectively. The

correct statement regarding them is
(1) A is suitable for drinking, whereas B is not
(2) B is more polluted than A
(3) Both A and B are suitable for drinking
(4) A is more polluted than B

Q46. Which primitive unit cell has unequal edge lengths ($a \neq b \neq c$) and all axial angles different from 90°
(1) Hexagonal
(2) Monoclinic
(3) Triclinic
(4) Tetragonal

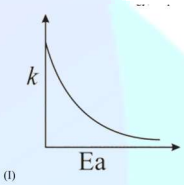
Q47. Liquids A and B form an ideal solution in the entire composition range. At 350 K , the vapour pressure of pure A and pure B are 7×10^3 Pa and 12×10^3 Pa, respectively. The composition of the vapour in equilibrium with a solution containing 40 mole percent of A at this temperature is:
(1) $x_A = 0.4; x_B = 0.6$
(2) $x_A = 0.76; x_B = 0.24$
(3) $x_A = 0.28; x_B = 0.72$
(4) $x_A = 0.37; x_B = 0.63$

Q48. Consider the following reduction processes:
$Zn^{2+} + 2e^- \rightarrow Zn(s); E^\circ = -0.76\ V$
$Ca^{2+} + 2e^- \rightarrow Ca(s); E^o = -2.87\ V$

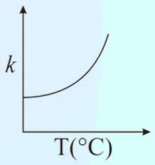
$Mg^{2+} + 2e^- \rightarrow Mg(\ s); E^o = -2.36\ V$
$Ni^{2+} + 2e^- \rightarrow Ni(\ s); E^o = -0.25\ V$

The reducing power of the metals increases in the order:
(1) $Ca < Mg < Zn < Ni$
(2) $Zn < Mg < Ni < Ca$
(3) $Ni < Zn < Mg < Ca$
(4) $Ca < Zn < Ni < Mg$

Q49. Consider the given plots for a reaction obeying Arrhenius equation $(0^\circ C < T < 300^\circ C)$: (Kand E_a are rate constant and activetion energy, respectively)



(I)



(II)

(1) I is wrong but II is right
(2) Both I and II are wrong
(3) I is right but II is wrong
(4) Both I and II are correct

Q50. Which of the following is not an example of heterogeneous catalysis reaction?
(1) Combustion of Coal
(2) Hydrogenation of Vegetable oils
(3) Ostwald's process
(4) Haber's process

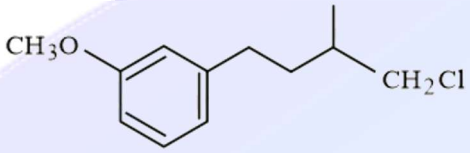
Q51.Hall Heroult's process is given by:
(1) $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + Cr$
(2) $2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$
(3) $Cu^{2+}(aq) + H_2(g) \rightarrow Cu(s) + 2H^+(aq)$
(4) $ZnO + C \xrightarrow{\text{Coke,1673}} Zn + CO$

Q52. The effect of lanthanoid contraction in the lanthanoid series of elements by and large means
(1) increase in atomic radii and decrease in ionic radii,
(3) increase in both atomic and ionic radii.
(2) decrease in atomic radii and increase in ionic radii.
(4) decrease in both atomic and ionic radii.

Q53. The total number of isomers for a square planar complex: $[MCl(F)(NO_2)(SCN)]$ is:
(1) 12
(2) 16
(3) 4
(4) 8

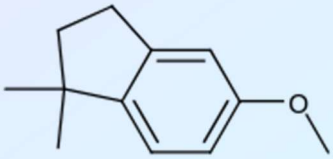
Q54. Wilkinson catalyst is
(1) $[(Et_3P)_3IrCl](Et = C_2H_5)$
(2) $[(Ph_3P)_3RhCl]$
(3) $[(Ph_3P)_3IrCl]$
(4) $[(Et_3P)_3RhCl]$

Q55. The major product of the following reaction is:

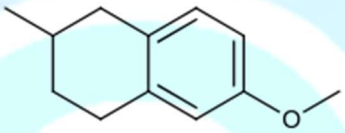


(i) $AlCl_3$ (anhydrous)
$\rightarrow$
(ii) H_2O

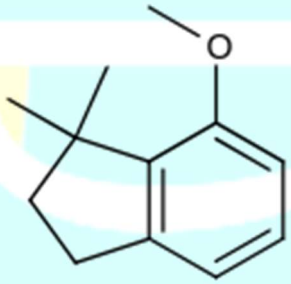
(1)



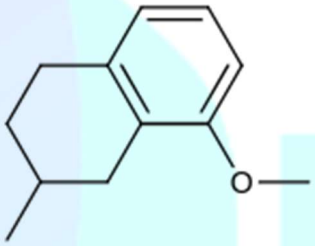
(2)



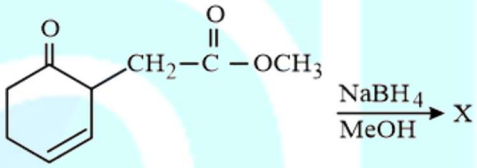
(3)



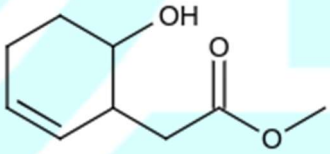
(4)



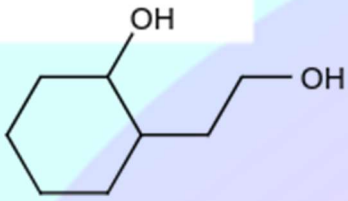
Q56. The major product ' X ' formed in the following reaction is:



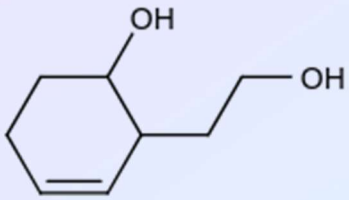
(1)



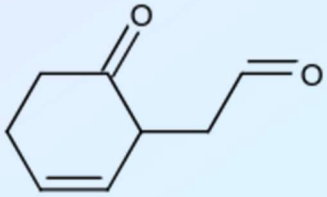
(2)



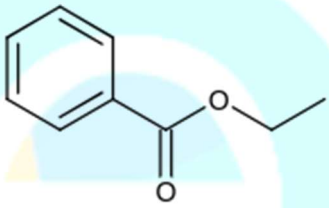
(3)



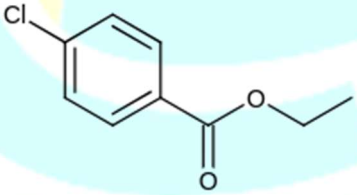
(4)



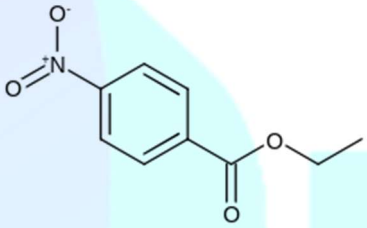
Q57.The decreasing order of ease of alkaline hydrolysis for the following esters is



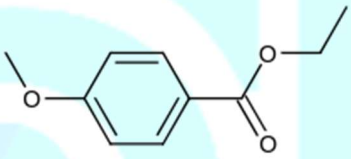
(I)



(II)



(III)

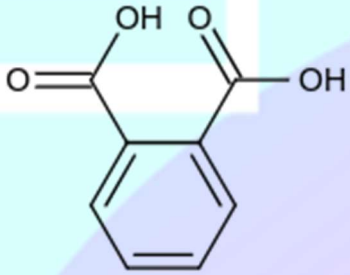


(IV)

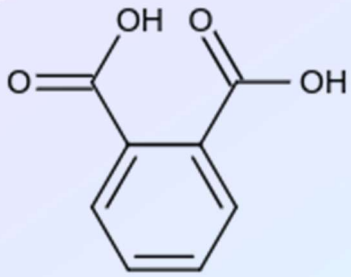
(1) III > II > IV > I
(2) III > II > I > IV
(3) IV > II > III > I
(4) II > III > I > IV

Q58. With dehydrating agent present which dicarboxylic acid is least reactive towards forming an anhydride?

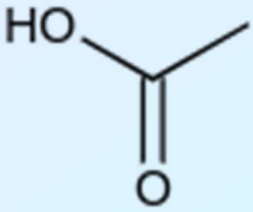
(1)

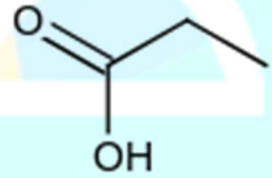


(2)

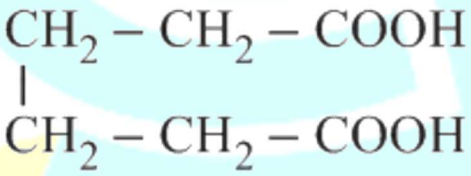


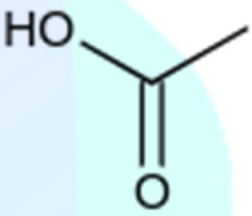
(3)



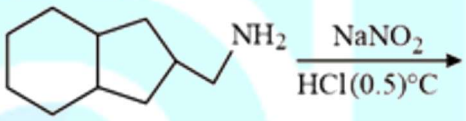


(4)

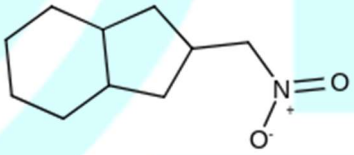




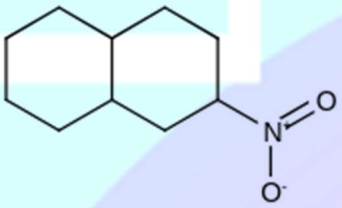
Q59. The major product formed in the reaction given below will be :



(1)

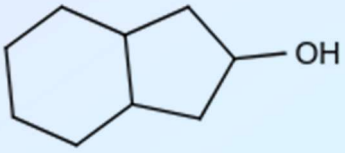


(2)



(3)

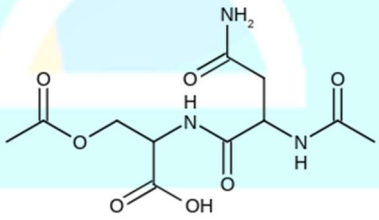
(4)



Q60. The correct structure of the product ' P ' in the following reaction is

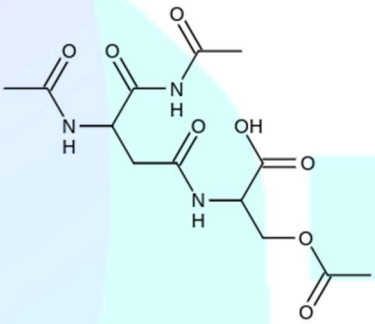
$$\text{Asn} - \text{Ser} + \underset{\text{(excess)}}{(CH_3CO)_2O} \xrightarrow{NEt_3} P$$

(1)

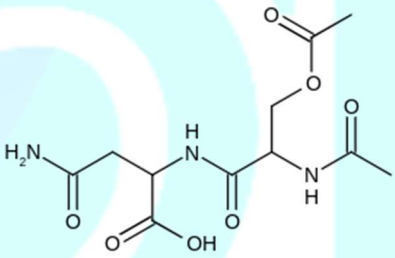


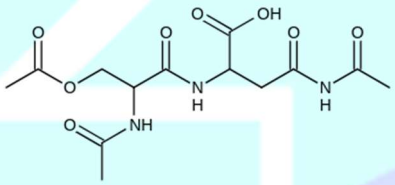
(2)

(3)



(4)





Q61. Consider the quadratic equation $(c-5)x^2 - 2cx + (c-4) = 0, c \neq 5$. Let S be the set of all integral values of c for which one root of the equation lies in the interval $(0,2)$ and its other root lies in the interval $(2,3)$. Then the number of elements in S is

(1) 11
(2) 12
(3) 18
(4) 10

Q62. Let z_1 and z_2 be any two non-zero complex numbers such that $3|z_1| = 4|z_2|$. If $z = \frac{3z_1}{2z_2} + \frac{2z_2}{3z_1}$ then maximum value of $|z|$ is

Note: In actual paper value of $|z|$ was asked. Hence, none of the options given were correct. So we have modified the question as well as options.

(1) $\frac{7}{2}$
(2) $\frac{9}{2}$
(3) $\frac{5}{2}$
(4) $\frac{1}{2}\sqrt{\frac{17}{2}}$

Q63.If $5,5r,5r^2$ are the lengths of the sides of a triangle, then r can not be equal to:

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

Q64. The sum of all two digit positive numbers which when divided by 7 yield 2 or 5 as remainder is

(1) 1356
(2) 1365
(3) 1256
(4) 1465

Q65. If $\sum_{i=1}^{20}\left(\frac{^{20}C_{i-1}}{^{20}C_i + {}^{20}C_{i-1}}\right)^3 = \frac{k}{21}$, then k equals

(1) 200
(2) 100
(3) 50
(4) 400

Q66.If the third term in the binomial expansion of $\left(1 + x^{\log_2 x}\right)^5$ equals 2560 , then a possible value of x is

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

Q67. The sum of all values of $\theta \in \left(0, \frac{\pi}{2}\right)$ satisfying $\sin^2 2\theta + \cos^4 2\theta = \frac{3}{4}$ is

(1) $\frac{\pi}{2}$
(2) $\frac{3\pi}{8}$
(3) $\frac{5\pi}{4}$
(4) π

Q68. If the line $3x + 4y - 24 = 0$ intersects the x-axis is at the point A and the y-axis at the point B, then the incentre of the triangle OAB, where O is the origin, is:

(1) (4,4)
(2) (3,4)
(3) (4,3)
(4) (2,2)

Q69. A point P moves on the line $2x - 3y + 4 = 0$. If $Q(1,4)$ and $R(3,-2)$ are fixed points, then the locus of the centroid of $\triangle PQR$ is a line:

(1) with slope $\frac{2}{3}$
(2) with slope $\frac{3}{2}$
(3) parallel to y-axis
(4) parallel to x-axis

Q70. If a circle C passing through the point $(4,0)$ touches the circle $x^2 + y^2 + 4x - 6y = 12$ externally at the point $(1,-1)$, then the radius of C is:

(1) 4 units
(2) 5 units
(3) $2\sqrt{5}$ units
(4) $\sqrt{57}$ units

Q71. If the parabolas $y^2 = 4b(x - c)$ and $y^2 = 8ax$ have a common normal, then which one of the following is a valid choice for the ordered triad (a, b, c)

(1) (1,1,3)
(2) $\left(\frac{1}{2}, 2, 0\right)$
(3) $\left(\frac{1}{2}, 2, 3\right)$
(4) All of above

Q72. The equation of a tangent to the hyperbola, $4x^2 - 5y^2 = 20$, parallel to the line $x - y = 2$, is

(1) $x - y + 7 = 0$
(2) $x - y - 3 = 0$
(3) $x - y + 1 = 0$
(4) $x - y + 9 = 0$

Q73. For each $t \in R$, let $[t]$ be the greatest integer less than or equal to t. Then,

$\lim_{x\to 1^+} \frac{(1-|x|+\sin|1-x|)\sin\left([1-x]\frac{\pi}{2}\right)}{|1-x[1-x]}$
(1) equals 0
(2) equals -1
(3) does not exist
(4) equal 1

Q74. Consider the statement: " $P(n): n^2-n+41$ is prime". Then which one of the following is true?
(1) $P(3)$ is false but $P(5)$ is true
(2) Both $P(3)$ and $P(5)$ are false
(3) Both $P(3)$ and $P(5)$ are true
(4) $P(5)$ is false but $P(3)$ is true

Q75. The mean of five observations is 5 and their variance is 9.20 . If three of the given five observations are 1,3 and 8 , then a ratio of other two observations is
(1) 10: 3
(2) 4: 9
(3) 6: 7
(4) 5: 8

Q76. Consider a triangular plot ABC with sides $AB = 7m, BC = 5m$ and $CA = 6m$. A vertical lamp-post at the mid-point D of AC subtends an angle $30°$ at B. The height (in m) of the lamp-post is:
(1) $2\sqrt{21}$
(2) $\frac{2}{3}\sqrt{21}$
(3) $\frac{3}{2}\sqrt{21}$
(4) $7\sqrt{3}$

Q77. In a class of 140 students numbered 1 to 140 , all even numbered students opted Mathematics course, those whose number is divisible by 3 opted Physics course and those whose number is divisible by 5 opted Chemistry course. Then the number of students who did not opt for any of the three courses is:
(1) 42
(2) 1
(3) 38
(4) 102

Q78. If the system of equations $x+y+z=5, x+2y+3z=9, x+3y+\alpha z=\beta$ has inifinitely many solutions, then $\beta-\alpha$ equals
(1) 8
(2) 21
(3) 5
(4) 18

Q79.
Let $d \in R$, and $A = \begin{bmatrix} -2 & 4+d & (\sin\theta)-2 \\ 1 & (\sin\theta)+2 & d \\ 5 & (2\sin\theta)-d & (-\sin\theta)+2+2d \end{bmatrix}, \theta \in [0,2\pi]$. If the minimum value of $\det(A)$ is 8 , then a value of d is:
(1) $2(\sqrt{2}+2)$
(2) $2(\sqrt{2}+1)$
(3) -5
(4) -7

Q80. Let $f(x) = \begin{cases} \max(|x|, x^2), & |x| \le 2 \\ 8-2|x|, & 2 < |x| \le 4 \end{cases}$.
Let S be the set of points in the interval $(-4,4)$ at which f is not differentiable. Then S
(1) equals $\{-2,-1,0,1,2\}$
(2) equals $\{-2,2\}$
(3) is an empty set
(4) equal $\{-2,-1,1,2\}$

Q81. Let, $f: R \to R$ be a function such that $f(x) = x^3 + x^2 f'(1) + xf''(2) + f'''(3), \forall x \in R$. Then $f(2)$ equals
(1) 30
(2) 8
(3) -4
(4) -2

Q82. The shortest distance between the point $\left(\frac{3}{2}, 0\right)$ and the curve $y = \sqrt{x}, (x > 0)$, is
(1) $\frac{\sqrt{3}}{2}$
(2) $\frac{5}{4}$
(3) $\frac{3}{2}$
(4) $\frac{\sqrt{5}}{2}$

Q83. Let, $n \ge 2$ be a natural number and $0 < \theta < \frac{\pi}{2}$. Then $\int \frac{(\sin^n\theta - \sin\theta)^{\frac{1}{n}}\cos\theta}{\sin^{n+1}\theta} d\theta$, is equal to
(1) $\frac{n}{n^2-1}\left(1-\frac{1}{\sin^{n+1}\theta}\right)^{\frac{n+1}{n}} + c$
(2) $\frac{n}{n^2+1}\left(1-\frac{1}{\sin^{n-1}\theta}\right)^{\frac{n+1}{n}} + c$

(3) $\frac{n}{n^2-1}\left(1-\frac{1}{\sin^{n-1}\theta}\right)^{\frac{n+1}{n}}+c$
(4) $\frac{n}{n^2-1}\left(1+\frac{1}{\sin^{n-1}\theta}\right)^{\frac{n+1}{n}}+c$

Q84. Let $I=\int_a^b (x^4-2x^2)dx$. If I is minimum then the ordered pair (a,b) is
(1) $(0,\sqrt{2})$
(2) $(\sqrt{2},-\sqrt{2})$
(3) $(-\sqrt{2},0)$
(4) $(-\sqrt{2},\sqrt{2})$

Q85. If the area enclosed between the curves $y=kx^2$ and $x=ky^2,(k>0)$, is 1 sq. unit. Then k is
(1) $\sqrt{3}$
(2) $\frac{1}{\sqrt{3}}$
(3) $\frac{\sqrt{3}}{2}$
(4) $\frac{2}{\sqrt{3}}$

Q86. If $\frac{dy}{dx}+\frac{3}{\cos^2 x}y=\frac{1}{\cos^2 x}, x\in\left(-\frac{\pi}{3},\frac{\pi}{3}\right)$, and $y\left(\frac{\pi}{4}\right)=\frac{4}{3}$, then $y\left(-\frac{\pi}{4}\right)$ equals
(1) $\frac{1}{3}$
(2) $\frac{1}{3}+e^3$
(3) $\frac{1}{3}+e^6$
(4) $-\frac{4}{3}$

Q87. Let $\vec{a}=2\hat{\imath}+\lambda_1\hat{\jmath}+3\hat{k}, \vec{b}=4\hat{\imath}+(3-\lambda_2)\hat{\jmath}+6\hat{k}$ and $\vec{c}=3\hat{\imath}+6\hat{\jmath}+(\lambda_3-1)\hat{k}$ be three vectors such that $\vec{b}=2\vec{a}$ and $\vec{a}$ is perpendicular to $\vec{c}$. Then a possible value of $(\lambda_1,\lambda_2,\lambda_3)$ is
(1) $\left(-\frac{1}{2},4,0\right)$
(2) $(1,5,1)$
(3) $\left(\frac{1}{2},4,-2\right)$
(4) $(1,3,1)$

Q88. Let A be a point on the line $\vec{r}=(1-3\mu)\hat{\imath}+(\mu-1)\hat{\jmath}+(2+5\mu)\hat{k}$ and $B(3,2,6)$ be a point in the space. Then the value of μ for which the vector $\overrightarrow{AB}$ is parallel to the plane $x-4y+3z=1$ is
(1) $\frac{1}{2}$
(2) $\frac{1}{4}$
(3) $-\frac{1}{4}$
(4) $\frac{1}{8}$

Q89. The plane passing through the point $(4,-1,2)$ and parallel to the lines $\frac{x+2}{3}=\frac{y-2}{-1}=\frac{z+1}{2}$ and $\frac{x-2}{1}=\frac{y-3}{2}=\frac{z-4}{3}$ also passes through the point
(1) $(1,1,-1)$
(2) $(-1,-1,-1)$
(3) $(-1,-1,1)$
(4) $(1,1,1)$

Q90. An unbiased coin is tossed. If the outcome is a head then a pair of unbiased dice is rolled and the sum of the numbers obtained on them is noted. If the toss of the coin results in tail then a card from a well-shuffled pack of nine cards numbered 1,2,3, ...,9 is randomly picked and the number on the card is noted. The probability that the noted number is either 7 or 8 is
(1) $\frac{13}{36}$
(2) $\frac{19}{72}$
(3) $\frac{15}{72}$
(4) $\frac{19}{36}$

ANSWER KEYS

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