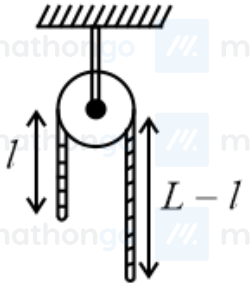
Q1. Consider the efficiency of Carnot's engine is given by $\eta = \frac{\alpha\beta}{\sin\theta}\log_e \frac{\beta x}{kT}$, where α and β are constants. If T is temperature, k is Boltzman constant, θ is angular displacement and x has the dimensions of length. Then, choose the incorrect option.

(1) Dimensions of β is same as that of force.
(2) Dimensions of $\alpha^{-1}x$ is same as that of energy.
(3) Dimensions of $\eta^{-1}\sin\theta$ is same as that of $\alpha\beta$
(4) Dimensions of α is same as that of β

Q2. At time $t = 0$ a particle starts travelling from a height $7\hat{z}$ cm in a plane keeping z coordinate constant. At any instant of time, it's position along the x and y directions are defined as $3t$ and $5t^3$ respectively. At $t = 1$ s acceleration of the particle will be

(1) $-30y$
(2) $30y$
(3) $3x + 15y$
(4) $3x + 15y + 7\hat{z}$

Q3. A uniform metal chain of mass m and length L passes over a massless and frictionless pulley. It is released from rest with a part of its length l is hanging on one side and rest of its length $L - l$ is hanging on the other side of the pulley. At a certain point of time, when $l = \frac{L}{x}$, the acceleration of the chain is $\frac{g}{2}$. The value of x is _____.



(1) 6
(2) 2
(3) 1.5
(4) 4

Q4. A bullet of mass 200 g having initial kinetic energy 90 J is shot inside a long swimming pool as shown in the figure. If it's kinetic energy reduces to 40 J within 1 s, the minimum length of the pool, the bullet has to travel so that it completely comes to rest is

(1) 45m
(2) 90m
(3) 125m
(4) 25m

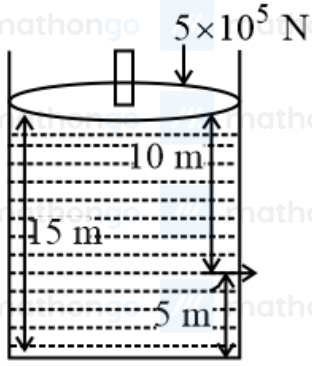
Q5. Assume there are two identical simple pendulum Clocks-1 is placed on the earth and Clock-2 is placed on a space station located at a height h above the earth surface. Clock-1 and Clock-2 operate at time periods 4 s and 6 s respectively. Then the value of h is -
(consider radius of earth $R_E = 6400$ km and g on earth 10 m s^{-2})

(1) 1200 km
(2) 1600 km
(3) 3200 km
(4) 4800 km

Q6. A pressure-pump has a horizontal tube of cross-sectional area 10 cm^2 for the outflow of water at a speed of 20 m s^{-1}. The force exerted on the vertical wall just in front of the tube which stops water horizontally flowing out of the tube, is: [given : density of water $= 1000$ kg m^{-3}]

(1) 300 N
(2) 500 N
(3) 250 N
(4) 400 N

Q7. Consider a cylindrical tank of radius 1 m is filled with water. The top surface of water is at 15 m from the bottom of the cylinder. There is a hole on the wall of cylinder at a height of 5 m from the bottom. A force of 5×10^5 N is applied an the top surface of water using a piston. The speed of efflux from the hole will be :
(given atmospheric pressure $P_A = 1.01 \times 10^5\ Pa$, density of water $\rho_w = 1000$ kg m^{-3} and gravitational acceleration $g = 10$ m s^{-2})

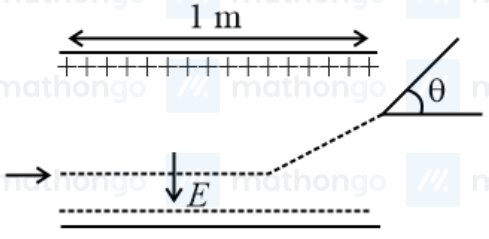


(1) 11.6 m s^{-1}
(2) 10.8 m s^{-1}
(3) 17.8 m s^{-1}
(4) 14.4 m s^{-1}

Q8. A vessel contains 14 g of nitrogen gas at a temperature of 27°C. The amount of heat to be transferred to the gas to double the r.m.s. speed of its molecules will be : (Take $R = 8.32$ J $\text{mol}^{-1}\,\text{k}^{-1}$)

(1) 2229 J
(2) 5616 J
(3) 9360 J
(4) 13, 104 J

Q9. A uniform electric field $E = \left(\frac{8m}{e}\right)\text{V m}^{-1}$ is created between two parallel plates of length 1 m as shown in figure, (where $m =$ mass of electron and $e =$ charge of electron). An electron enters the field symmetrically between the plates with a speed of 2 m s^{-1}. The angle of the deviation (θ) of the path of the electron as it comes out of the field will be _____ .



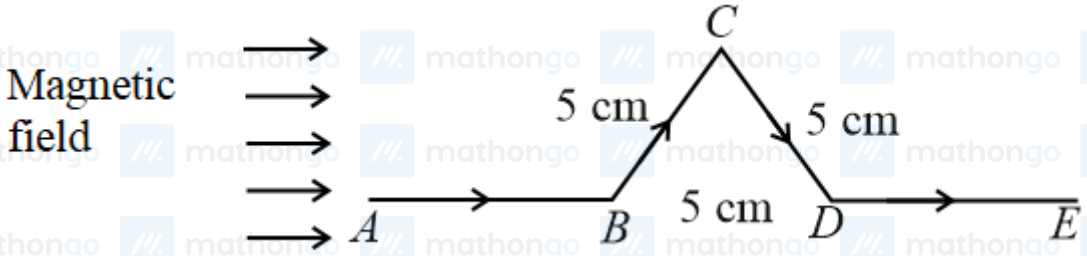
(1) $\tan^{-1}(4)$
(2) $\tan^{-1}(2)$
(3) $\tan^{-1}\left(\frac{1}{3}\right)$
(4) $\tan^{-1}(3)$

Q10. A slab of dielectric constant K has the same crosssectional area as the plates of a parallel plate capacitor and thickness $\frac{3}{4}d$, where d is the separation of the plates. The capacitance of the capacitor when the slab is inserted

between the plates will be :
(Given C_0 = capacitance of capacitor with air as medium between plates.)
(1) $\frac{4KC_0}{3+K}$ (2) $\frac{3KC_0}{3+K}$
(3) $\frac{3+K}{4KC_0}$ (4) $\frac{K}{4+K}$

Q11. Given below are two statements :
Statement I : A uniform wire of resistance 80 Ω is cut into four equal parts. These parts are now connected in parallel. The equivalent resistance of the combination will be 5 Ω.
Statement II : Two resistance $2R$ and $3R$ are connected in parallel in an electric circuit. The value of thermal energy developed in $3R$ and $2R$ will be in the ratio 3 : 2.
In the light of the above statements, choose the most appropriate answer from the options given below
(1) Both statement I and statement II are correct (2) Both statement I and statement II are incorrect
(3) Statement I is correct but statement II is incorrect (4) Statement I is incorrect but statement II is correct.

Q12. A triangular shaped wire carrying 10 A current is placed in a uniform magnetic field of 0.5 T, as shown in figure. The magnetic force on segment CD is (Given $BC = CD = BD = 5$ cm).



(1) 0.126 N (2) 0.312 N
(3) 0.216 N (4) 0.245 N

Q13. The magnetic field at the center of current carrying circular loop is B_1. The magnetic field at a distance of $\sqrt{3}$ times radius of the given circular loop from the center on its axis is B_2. The value of $\frac{B_1}{B_2}$ will be
(1) 9 : 4 (2) 12 : $\sqrt{5}$
(3) 8 : 1 (4) 5 : $\sqrt{3}$

Q14. A transformer operating at primary voltage 8 kV and secondary voltage 160 V serves a load of 80 kW. Assuming the transformer to be ideal with purely resistive load and working on unity power factor, the loads in the primary and secondary circuit would be
(1) 800 Ω and 1.06 Ω (2) 10 Ω and 500 Ω
(3) 800 Ω and 0.32 Ω (4) 1.06 Ω and 500 Ω

Q15. Sun light falls normally on a surface of area 36 cm^2 and exerts an average force of 7.2×10^{-9} N within a time period of 20 minutes. Considering a case of complete absorption, the energy flux of incident light is
(1) 25.92×10^2 W cm^{-2} (2) 8.64×10^{-6} W cm^{-2}
(3) 6.0 W cm^{-2} (4) 0.06 W cm^{-2}

Q16. The power of a lens (biconvex) is 1.25 m^{-1} in particular medium. Refractive index of the lens is 1.5 and radii of curvature are 20 cm and 40 cm respectively. The refractive index of surrounding medium:

(1) 1.0 (2) $\frac{9}{7}$
(3) $\frac{3}{2}$ (4) $\frac{4}{3}$

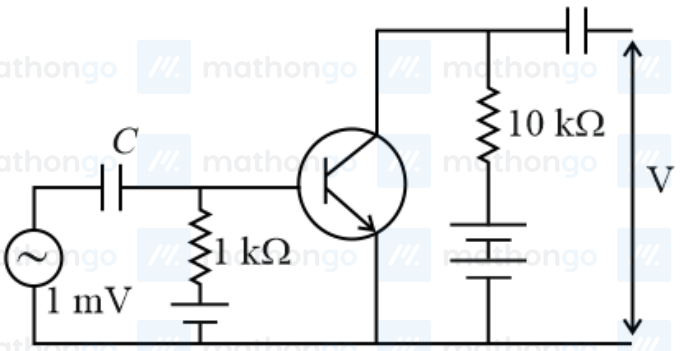
Q17. Two streams of photons, possessing energies to five and ten times the work function of metal are incident on the metal surface successively. The ratio of the maximum velocities of the photoelectron emitted, in the two cases respectively, will be

(1) $1:2$ (2) $1:3$
(3) $2:3$ (4) $3:2$

Q18. A radioactive sample decays $\frac{7}{8}$ times its original quantity in 15 minutes. The half-life of the sample is

(1) $5\ \text{min}$ (2) $7.5\ \text{min}$
(3) $15\ \text{min}$ (4) $30\ \text{min}$

Q19. An n.p.n transistor with current gain $\beta = 100$ in common emitter configuration is shown in figure. The output voltage of the amplifier will be



(1) 0.1 V (2) 1.0 V
(3) 10 V (4) 100 V

Q20. A FM Broad cast transmitter, using modulating signal of frequency 20 kHz has a deviation ratio of 10. The Bandwidth required for transmission is :

(1) 220 kHz (2) 180 kHz
(3) 360 kHz (4) 440 kHz

Q21. In an experiment to find acceleration due to gravity (g) using simple pendulum, time period of 0.5 s is measured from time of 100 oscillation with a watch of 1 s resolution. If measured value of length is $10\ \text{cm}$ known to $1\ \text{mm}$ accuracy. The accuracy in the determination of g is found to be $x\%$. The value of x is

Q22. A ball is thrown vertically upwards with a velocity of $19.6\ \text{m s}^{-1}$ from the top of a tower. The ball strikes the ground after 6 s. The height from the ground up to which the ball can rise will be $\left(\frac{k}{5}\right)$ m. The value of k is _____ (use $g = 9.8\ \text{m s}^{-2}$)

Q23. The distance of centre of mass from end A of a one dimensional rod (AB) having mass density $\rho = \rho_0\left(1 - \frac{x^2}{L^2}\right)\ \text{kg m}^{-1}$ and length L (in meter) is $\frac{3L}{\alpha}$ m. The value of α is _____ (where x is the distance form end A)

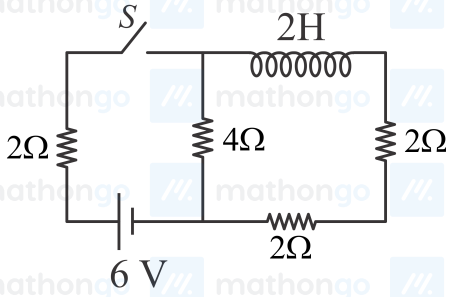
Q24. A string of area of cross-section $4\ \text{mm}^2$ and length 0.5 is connected with a rigid body of mass $2\ \text{kg}$. The body is rotated in a vertical circular path of radius $0.5\ \text{m}$. The body acquires a speed of $5\ \text{m s}^{-1}$ at the bottom of the circular path. Strain produced in the string when the body is at the bottom of the circle is _____ $\times 10^{-5}$. (Use Young's modulus $10^{11}\ \text{N m}^{-2}$ and $g = 10\ \text{m s}^{-2}$)

Q25. At a certain temperature, the degrees of freedom per molecule for gas is 8. The gas performs 150 J of work when it expands under constant pressure. The amount of heat absorbed by the gas will be _____ J.

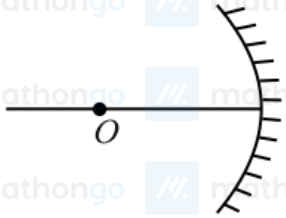
Q26. The potential energy of a particle of mass $4\ \text{kg}$ in motion along the x-axis is given by $\text{U} = 4(1 - \cos 4\text{x})$ J. The time period of the particle for small oscillation $(\sin\theta \simeq \theta)$ $\left(\frac{\pi}{\text{K}}\right)$ s. The value of K is _____ .

Q27. An electrical bulb rated 220 V, 100 W, is connected in series with another bulb rated 220 V, 60 W. If the voltage across combination is 220 V, the power consumed by the 100 W bulb will be about _____ W.

Q28. For the given circuit the current through battery of 6 V just after closing the switch 'S' will be _____ A.



Q29. An object 'O' is placed at a distance of $100\ \text{cm}$ in front of a concave mirror of radius of curvature $200\ \text{cm}$ as shown in the figure. The object starts moving towards the mirror at a speed $2\ \text{cm s}^{-1}$. The position of the image from the mirror after 10 s will be at _____ cm.



Q30. In an experiment with a convex lens. The plot of the image distance (v') against the object distance (μ') measured from the focus gives a curve $v'\mu' = 225$. If all the distances are measured in cm. The magnitude of the focal length of the lens is _____ cm.

Q31. Which of the following pair is not isoelectronic species?
(Atomic numbers $\text{Sm} = 62;\ \text{Er} = 68;\ \text{Yb} = 70;\ \text{Lu} = 71;\ \text{Eu} = 63;\ \text{Tb} = 65;\ \text{Tm} = 69$)
(1) Sm^{2+} and Er^{3+}
(2) Yb^{2+} and Lu^{3+}
(3) Eu^{2+} and Tb^{4+}
(4) Tb^{2+} and Tm^{4+}

Q32. The correct decreasing order for metallic character is
(1) $\text{Na} > \text{Mg} > \text{Be} > \text{Si} > \text{P}$
(2) $\text{P} > \text{Si} > \text{Be} > \text{Mg} > \text{Na}$
(3) $\text{Si} > \text{P} > \text{Be} > \text{Na} > \text{Mg}$
(4) $\text{Be} > \text{Na} > \text{Mg} > \text{Si} > \text{P}$

Q33. Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R
Assertion A : Zero orbital overlap is an out of phase overlap.
Reason R : It results due to different orientation/ direction of approach of orbitals.
In the light of the above statements. Choose the correct answer from the options given below
(1) Both A and R are true and R is the correct explanation of A
(2) Both A and R are true but R is NOT the correct explanation of A
(3) A is true but R is false
(4) A is false but R is true

Q34. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R
Assertion A : The reduction of a metal oxide is easier if the metal formed is in liquid state than solid state.
Reason R : The value of ΔG^{Θ} becomes more on negative side as entropy is higher in liquid state than solid state.
In the light of the above statements. Choose the most appropriate answer from the options given below
(1) Both A and R are correct and R is the correct explanation of A
(2) Both A and R are correct but R is NOT the correct explanation of A
(3) A is correct but R is not correct
(4) A is not correct but R is correct

Q35. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R
Assertion A : Permanganate titration are not performed in presence of hydrochloric acid.
Reason R : Chlorine is formed as a consequence of oxidation of hydrochloric acid.
In the light of the above statements, choose the correct answer from the options given below
(1) Both A and R are true and R is the correct explanation of A
(2) Both A and R are true but R is NOT the correct explanation of A
(3) A is true but R is false
(4) A is false but R is true

Q36. The products obtained during treatment of hard water using Clark's method are
(1) $CaCO_3$ and $MgCO_3$
(2) $Ca(OH)_2$ and $Mg(OH)_2$
(3) $CaCO_3$ and $Mg(OH)_2$
(4) $Ca(OH)_2$ and $MgCO_3$

Q37. Statement I: An alloy of lithium and magnesium is used to make aircraft plates.
Statement II : The magnesium ions are important for cell-membrane integrity.
In the light the above statements, choose the correct answer from the options given below
(1) Both Statement I and Statement II are true
(2) Both Statement I and Statement II are false
(3) Statement I is true but Statement II is false
(4) Statement I is false but Statement II is true

Q38. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R
Assertion A : Thin layer chromatography is an adsorption chromatography.
Reason R : A thin layer of silica gel is spread over a glass plate of suitable size in thin layer chromatography which acts as an adsorbent. In the light of the above statements, choose the correct answer from the options given below
(1) Both A and R are true and R is the correct explanation of A
(2) Both A and R are true but R is NOT the correct explanation of A
(3) A is true but R is false
(4) A is false but R is true

Q39. Arrange the following in increasing order of reactivity towards nitration

A. p-xylene

B. bromobenzene

C. mesitylene

D. nitrobenzene

E. benzene

Choose the correct answer from the options given below

(1) $C < D < E < A < B$

(2) $D < B < E < A < C$

(3) $D < C < E < A < B$

(4) $C < D < E < B < A$

Q40. White phosphorus reacts with thionyl chloride to give

(1) PCl_5, SO_2 and S_2Cl_2

(2) PCl_3, SO_2 and S_2Cl_2

(3) PCl_3, SO_2 and Cl_2

(4) PCl_5, SO_2 and Cl_2

Q41. Concentrated HNO_3 reacts with Iodine to give

(1) HI, NO_2 and H_2O

(2) HIO_2, N_2O and H_2O

(3) HIO_3, NO_2 and H_2O

(4) HIO_4, N_2O and H_2O

Q42. Dinitrogen and dioxygen the main constituents of air do not react with each other in atmosphere to form oxides of nitrogen because

(1) N_2 is unreactive in the condition of atmosphere.

(2) Oxides of nitrogen are unstable.

(3) Reaction between them can occur in the presence of a catalyst.

(4) The reaction is endothermic and require very high temperature.

Q43. Match List-I with List-II

	List-I (Complex)		**List-II (Hybridization)**
A	$Ni(CO)_4$	I	sp^3
B	$[Ni(CN)_4]^{2-}$	II	sp^3d^2
C	$[Co(CN)_6]^{3-}$	III	d^2sp^3
D	$[CoF_6]^{3-}$	IV	dsp^2

Choose the correct answer from the options given below

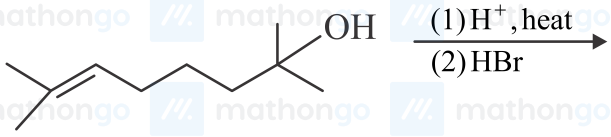
(1) $A-IV, B-I, C-III, D-II$

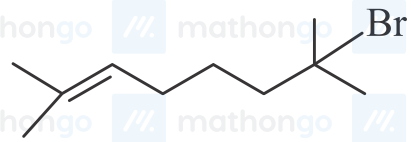
(2) $A-I, B-IV, C-III, D-II$

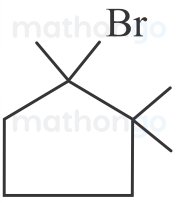
(3) $A-I, B-IV, C-II, D-III$

(4) $A-IV, B-I, C-II, D-III$

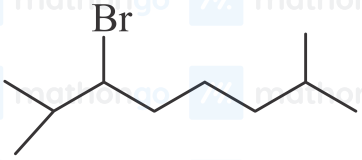
Q44. The major product in the given reaction is



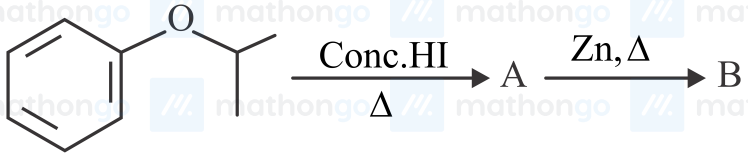
(1) 

(2) 

(3) 

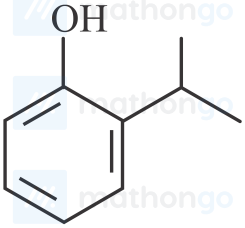
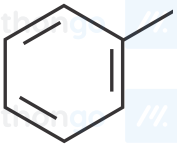
(4) 

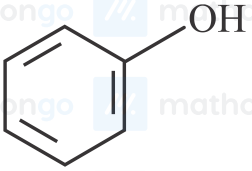
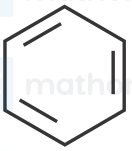
Q45. Compound I is heated with Conc. HI to give a hydroxy compound A which is further heated with Zn dust to give compound B. Identify A and B.

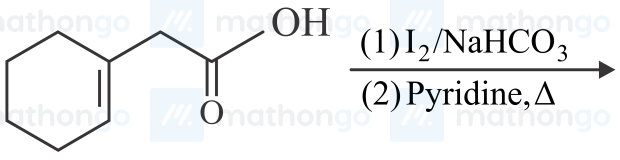


(1) A =  , B = 

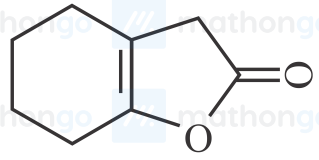
(2) A =  , B = 

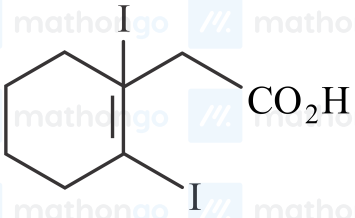
(3) A =  , B = 

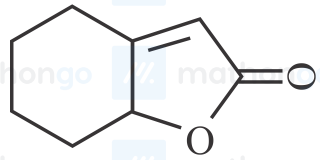
(4) A =  , B = 

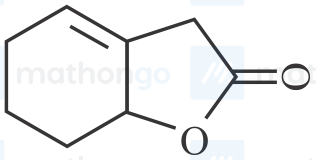
Q46. 

Find out the major product for the above reaction.

(1) 

(2) 

(3) 

(4) 

Q47. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R

Assertion A : Aniline on nitration yields ortho, meta & para nitro derivatives of aniline.

Reason R : Nitrating mixture is a strong acidic mixture.

In the light of the above statements, choose the correct answer from the options given below

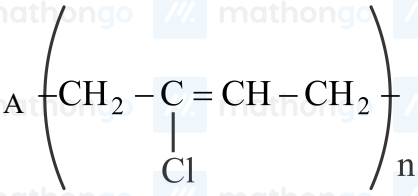
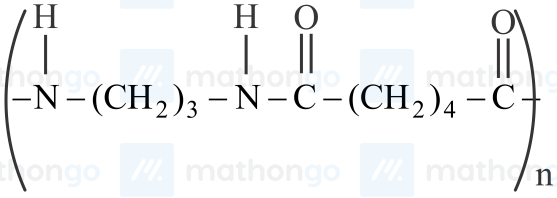
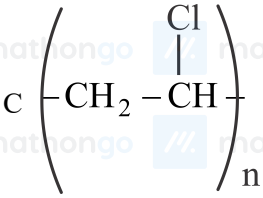
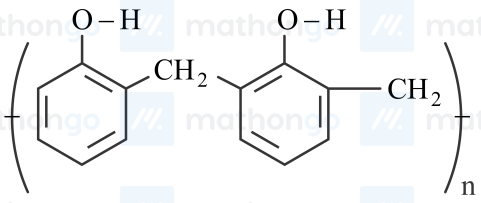
(1) Both A and R are true and R is the correct explanation of A

(2) Both A and R are true but R is NOT the correct explanation of A

(3) A is true but R is false

(4) A is false but R is true

Q48. Match List I with List II

List-I (Polymer)	**List-II (Nature)**
A 	I Thermosetting polymer
B 	II Fibers
C 	III Elastomer
D 	IV Thermoplastic polymer

Choose the correct answer from the options given below

(1) A – II, B – III, C – IV, D – I

(2) A – III, B – II, C – IV, D – I

(3) A – III, B – I, C – IV, D – II

(4) A – I, B – III, C – IV, D – II

Q49. Two statements in respect of drug-enzyme interaction are given below

Statement I : Action of an enzyme can be blocked only when an inhibitor blocks the active site of the enzyme.

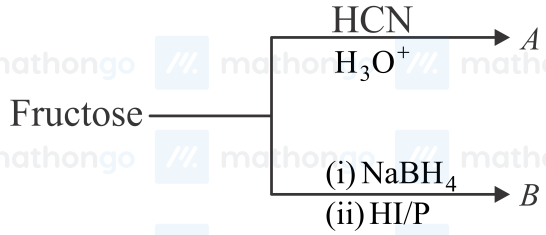
Statement II : An inhibitor can form a strong covalent bond with the enzyme.

In the light of the above statements. Choose the correct answer from the options given below

(1) Both Statement I and Statement II are true (2) Both Statement I and Statement II are false

(3) Statement I is true but Statement II is false (4) Statement I is false but Statement II is true

Q50. The formulas of A and B for the following reaction sequence are



(1) $A = C_7H_{14}O_8, B = C_6H_{14}$ (2) $A = C_7H_{13}O_7, B = C_7H_{14}O$

(3) $A = C_7H_{12}O_8, B = C_6H_{14}$ (4) $A = C_7H_{14}O_8, B = C_6H_{14}O_6$

Q51. 2 L of $0.2\,M H_2SO_4$ is reacted with 2 L of $0.1\,M NaOH$ solution, the molarity of the resulting product Na_2SO_4 in the solution is____millimolar.

Q52. If the wavelength for an electron emitted from H− atom is 3.3×10^{-10} m, then energy absorbed by the electron in its ground state compared to minimum energy required for its escape from the atom, is____times.

[Given : $h = 6.626 \times 10^{-34}$ Js, Mass of electron $= 9.1 \times 10^{-31}$]

Q53. Among the following the number of state variable is

Internal energy (U)

Volume (V)

Heat (q)

Enthalpy (H)

Q54. At 600 K, 2 mol of NO are mixed with 1 mol of O_2.

$2NO_{(g)} + O_2(g) \rightleftarrows 2NO_2(g)$

The reaction occurring as above comes to equilibrium under a total pressure of 1 atm. Analysis of the system shows that 0.6 mol of oxygen are present at equilibrium. The equilibrium constant for the reaction is____.

Q55. On reaction with stronger oxidizing agent like KIO_4, hydrogen peroxide oxidizes with the evolution of O_2. The oxidation number of I in KIO_4 changes to

Q56. A sample of 0.125 g of an organic compound when analysed by Duma's method yields 22.78 mL of nitrogen gas collected over KOH solution at 280 K and 759 mmHg. The percentage of nitrogen in the given organic compound is____

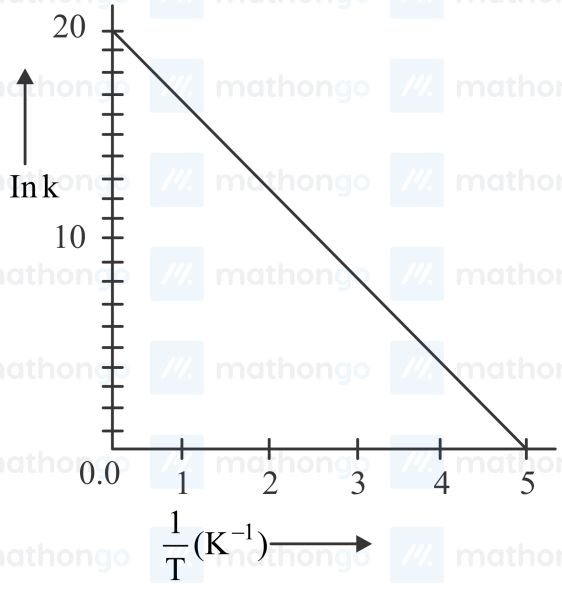
(a) The vapour pressure of water at 280 K is 14.2 mmHg

(b) $R = 0.082\ L\ atm\ K^{-1}\ mol^{-1}$

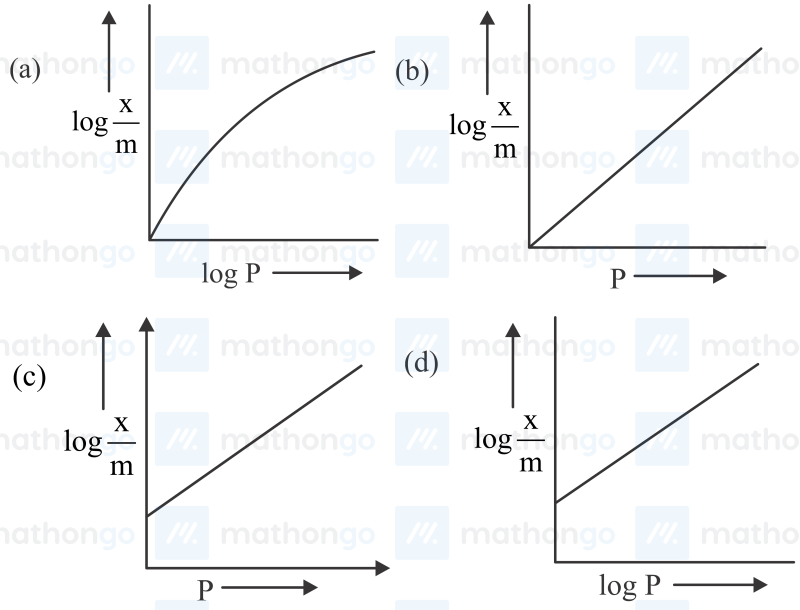
Q57. Metal M crystallizes into a FCC lattice with the edge length of 4.0×10^{-8} cm. The atomic mass of the metal is g/ mol.
(Use : $N_A = 6.02 \times 10^{23}$ mol^{-1}, density of metal, $M = 9.03$ g cm^{-3})

Q58. A gaseous mixture of two substances A and B, under a total pressure of 0.8 atm is in equilibrium with an ideal liquid solution. The mole fraction of substance A is 0.5 in the vapour phase and 0.2 in the liquid phase. The vapour pressure of pure liquid A is____atm.(Nearest integer)

Q59. For a reaction, given below is the graph of lnk vs $\frac{1}{T}$. The activation energy for the reaction is equal to____ cal mol^{-1}.(Given : $R = 2\,calK^{-1}$ mol^{-1})



Q60. Among the following the number of curves not in accordance with Freundlich adsorption isotherm is



Q61. Let $S = \left\{x \in [-6,3] - \{-2,2\} : \frac{|x+3|-1}{|x|-2} \geq 0\right\}$ and $T = \left\{x \in Z : x^2 - 7|x| + 9 \leq 0\right\}$. Then the number of elements in $S \cap T$ is

(1) 7 (2) 5
(3) 4 (4) 3

Q62. Let α, β be the roots of the equation $x^2 - \sqrt{2}x + \sqrt{6} = 0$ and $\frac{1}{\alpha^2} + 1, \frac{1}{\beta^2} + 1$ be the roots of the equation $x^2 + ax + b = 0$. Then the roots of the equation $x^2 - (a + b - 2)x + (a + b + 2) = 0$ are :
(1) non-real complex numbers (2) real and both negative
(3) real and both positive (4) real and exactly one of them is positive

Q63. Let the tangents at two points A and B on the circle $x^2 + y^2 - 4x + 3 = 0$ meet at origin $O(0, 0)$. Then the area of the triangle of OAB is
(1) $\frac{3\sqrt{3}}{2}$ (2) $\frac{3\sqrt{3}}{4}$
(3) $\frac{3}{2\sqrt{3}}$ (4) $\frac{3}{4\sqrt{3}}$

Q64. Let the hyperbola $H : \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ pass through the point $\left(2\sqrt{2}, -2\sqrt{2}\right)$. A parabola is drawn whose focus is same as the focus of H with positive abscissa and the directrix of the parabola passes through the other focus of H. If the length of the latus rectum of the parabola is e times the length of the latus rectum of H, where e is the eccentricity of H, then which of the following points lies on the parabola?
(1) $\left(2\sqrt{3}, 3\sqrt{2}\right)$ (2) $\left(3\sqrt{3}, -6\sqrt{2}\right)$
(3) $\left(\sqrt{3}, -\sqrt{6}\right)$ (4) $\left(3\sqrt{6}, 6\sqrt{2}\right)$

Q65. Let
$\boldsymbol{p}$: Ramesh listens to music.
$\boldsymbol{q}$: Ramesh is out of his village
$\boldsymbol{r}$: It is Sunday
$\boldsymbol{s}$ **:** It is Saturday
Then the statement "Ramesh listens to music only if he is in his village and it is Sunday or Saturday" can be expressed as
(1) $((\sim q) \wedge (r \vee s)) \Rightarrow p$ (2) $(q \wedge (r \vee s)) \Rightarrow p$
(3) $p \Rightarrow (q \wedge (r \vee s))$ (4) $p \Rightarrow ((\sim q) \wedge (r \vee s))$

Q66. A horizontal park is in the shape of a triangle OAB with $AB = 16$. A vertical lamp post OP is erected at the point O such that $\angle PAO = \angle PBO = 15^\circ$ and $\angle PCO = 45^\circ$, where C is the midpoint of AB. Then $(OP)^2$ is equal to
(1) $\frac{32}{\sqrt{3}}\left(\sqrt{3} - 1\right)$ (2) $\frac{32}{\sqrt{3}}\left(2 - \sqrt{3}\right)$
(3) $\frac{16}{\sqrt{3}}\left(\sqrt{3} - 1\right)$ (4) $\frac{16}{\sqrt{3}}\left(2 - \sqrt{3}\right)$

Q67. Let A and B be any two 3×3 symmetric and skew symmetric matrices respectively. Then which of the following is **NOT** true?
(1) $A^4 - B^4$ is a symmetric matrix (2) $AB - BA$ is a symmetric matrix
(3) $B^5 - A^5$ is a skew-symmetric matrix (4) $AB + BA$ is a skew-symmetric matrix

Q68. Let $f(x) = ax^2 + bx + c$ be such that $f(1) = 3,\ f(-2) = \lambda$ and $f(3) = 4$. If $f(0) + f(1) + f(-2) + f(3) = 14$, then λ is equal to

(1) -4 (2) $\frac{13}{2}$
(3) $\frac{23}{2}$ (4) 4

Q69. The function $f : R \to R$ defined by $f(x) = \lim\limits_{n\to\infty} \frac{\cos(2\pi x) - x^{2n}\sin(x-1)}{1+x^{2n+1}-x^{2n}}$ is continuous for all x in

(1) $R - \{-1\}$ (2) $R - \{-1, 1\}$
(3) $R - \{1\}$ (4) $R - \{0\}$

Q70. Let $x(t) = 2\sqrt{2}\cos t\sqrt{\sin 2t}$ and $y(t) = 2\sqrt{2}\sin t\sqrt{\sin 2t}, t \in \left(0, \frac{\pi}{2}\right)$. Then $\frac{1+\left(\frac{dy}{dx}\right)^2}{\frac{d^2y}{dx^2}}$ at $t = \frac{\pi}{4}$ is equal to

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

Q71. The function $f(x) = xe^{x(1-x)}, x \in R$, is

(1) increasing in $\left(-\frac{1}{2}, 1\right)$ (2) decreasing in $\left(\frac{1}{2}, 2\right)$
(3) increasing in $\left(-1, -\frac{1}{2}\right)$ (4) decreasing in $\left(-\frac{1}{2}, \frac{1}{2}\right)$

Q72. The sum of the absolute maximum and absolute minimum values of the function $f(x) = \tan^{-1}(\sin x - \cos x)$ in the interval $[0, \pi]$ is

(1) 0 (2) $\tan^{-1}\left(\frac{1}{\sqrt{2}}\right) - \frac{\pi}{4}$
(3) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right) - \frac{\pi}{4}$ (4) $\frac{-\pi}{12}$

Q73. Let $I_n(x) = \int_0^x \frac{1}{(t^2+5)^n}dt, n = 1, 2, 3, \ldots$. Then

(1) $50I_6 - 9I_5 = xI_5'$ (2) $50I_6 - 11I_5 = xI_5'$
(3) $50I_6 - 9I_5 = I_5'$ (4) $50I_6 - 11I_5 = I_5'$

Q74. The area enclosed by the curves $y = \log_e(x + e^2)$, $x = \log_e\left(\frac{2}{y}\right)$ and $x = \log_e 2$, above the line $y = 1$ is

(1) $2 + e - \log_e 2$ (2) $1 + e - \log_e 2$
(3) $e - \log_e 2$ (4) $1 + \log_e 2$

Q75. Let $y = y(x)$ be the solution curve of the differential equation $\frac{dy}{dx} + \frac{1}{x^2-1}y = \left(\frac{x-1}{x+1}\right)^{\frac{1}{2}}, x > 1$ passing through the point $\left(2, \sqrt{\frac{1}{3}}\right)$. Then $\sqrt{7}\mathrm{y}(8)$ is equal to

(1) $11 + 6\log_e 3$ (2) 19
(3) $12 - 2\log_e 3$ (4) $19 - 6\log_e 3$

Q76. The differential equation of the family of circles passing through the points $(0, 2)$ and $(0, -2)$ is

(1) $2xy\frac{dy}{dx} + \left(x^2 - y^2 + 4\right) = 0$ (2) $2xy\frac{dy}{dx} + \left(x^2 + y^2 - 4\right) = 0$
(3) $2xy\frac{dy}{dx} + \left(y^2 - x^2 + 4\right) = 0$ (4) $2xy\frac{dy}{dx} - \left(x^2 - y^2 + 4\right) = 0$

Q77. Let S be the set of all $a \in R$ for which the angle between the vectors $\vec{u} = a(\log_e b)\hat{i} - 6\hat{j} + 3\hat{k}$ and $\vec{v} = (\log_e b)\hat{i} + 2\hat{j} + 2a(\log_e b)\hat{k}, (b > 1)$ is acute. Then S is equal to

(1) $\left(-\infty, -\frac{4}{3}\right)$ (2) Φ
(3) $\left(-\frac{4}{3}, 0\right)$ (4) $\left(\frac{12}{7}, \infty\right)$

Q78. Let the lines $\frac{x-1}{\lambda}=\frac{y-2}{1}=\frac{z-3}{2}$ and $\frac{x+26}{-2}=\frac{y+18}{3}=\frac{z+28}{\lambda}$ be coplanar and P be the plane containing these two lines. Then which of the following points does NOT lies on P ?

(1) $(0,-2,-2)$ (2) $(-5,0,-1)$

(3) $(3,-1,0)$ (4) $(0,4,5)$

Q79. A plane P is parallel to two lines whose direction ratios are $-2,1,-3$, and $-1,2,-2$ and it contains the point $(2,2,-2)$. Let P intersect the co-ordinate axes at the points A, B, C making the intercepts α, β, γ. If V is the volume of the tetrahedron $OABC$, where O is the origin and $\mathrm{p}=\alpha+\beta+\gamma$, then the ordered pair (V, p) is equal to

(1) $(48,-13)$ (2) $(24,-13)$

(3) $(48,11)$ (4) $(24,-5)$

Q80. Let A and B be two events such that $P(B \mid A)=\frac{2}{5}$, $P(A \mid B)=\frac{1}{7}$ and $P(A \cap B)=\frac{1}{9}$. Consider

$(S1) P(A' \cup B)=\frac{5}{6}$,

$(S2) P(A' \cap B')=\frac{1}{18}$. Then

(1) Both (S1) and (S2) are true (2) Both $(S1)$ and $(S2)$ are false

(3) Only $(S1)$ is true (4) Only $(S2)$ is true

Q81. Let $\mathrm{z}=\mathrm{a}+ib,\ \mathrm{b} \neq 0$ be complex numbers satisfying $\mathrm{z}^2=\bar{\mathrm{z}} \cdot 2^{1-|z|}$. Then the least value of $n \in N$, such that $z^n=(z+1)^n$, is equal to _____ .

Q82. A class contains b boys and g girls. If the number of ways of selecting 3 boys and 2 girls from the class is 168, then $b+3g$ is equal to

Q83. If $\frac{6}{3^{12}}+\frac{10}{3^{11}}+\frac{20}{3^{10}}+\frac{40}{3^9}+\ldots\ldots+\frac{10240}{3}=2^n \cdot m$, where m is odd, then $m.n$ is equal to _____ .

Q84. Let the coefficients of the middle terms in the expansion of $\left(\frac{1}{\sqrt{6}}+\beta x\right)^4,(1-3\beta x)^2$ and $\left(1-\frac{\beta}{2}x\right)^6, \beta>0$, respectively form the first three terms of an A.P. If d is the common difference of this A.P., then $50-\frac{2d}{\beta^2}$ is equal to _____ .

Q85. If $1+\left(2+{}^{49}\mathrm{C}_1+{}^{49}\mathrm{C}_2+\ldots\ldots+{}^{49}\mathrm{C}_{49}\right)\left({}^{50}\mathrm{C}_2+{}^{50}\mathrm{C}_4+\ldots\ldots+{}^{50}\mathrm{C}_{50}\right)$ is equal to $2^n.m$, where m is odd, then $n+m$ is equal to _____ .

Q86. Let $S=\left[-\pi, \frac{\pi}{2}\right)-\left\{-\frac{\pi}{2},-\frac{\pi}{4},-\frac{3\pi}{4}, \frac{\pi}{4}\right\}$. Then the number of elements in the set $A=\left\{\theta \in \mathrm{S}: \tan\theta\left(1+\sqrt{5}\tan(2\theta)\right)=\sqrt{5}-\tan(2\theta)\right\}$ is _____ .

Q87. Two tangent lines l_1 and l_2 are drawn from the point $(2,0)$ to the parabola $2y^2=-x$. If the lines l_1 and l_2 are also tangent to the circle $(x-5)^2+y^2=r$, then $17r^2$ is equal to

Q88. Let the tangents at the points P and Q on the ellipse $\frac{x^2}{2}+\frac{y^2}{4}=1$ meet at the point $R\left(\sqrt{2}, 2\sqrt{2}-2\right)$. If S is the focus of the ellipse on its negative major axis, then SP^2+SQ^2 is equal to

Q89. The value of the integral $\int_0^{\frac{\pi}{2}} 60\frac{\sin(6x)}{\sin x}dx$ is equal to

Q90. A bag contains 4 white and 6 black balls. Three balls are drawn at random from the bag. Let X be the number of white balls, among the drawn balls. If σ^2 is the variance of X, then $100\sigma^2$ is equal to

ANSWER KEYS

1. (4)	**2.** (2)	**3.** (4)	**4.** (1)	**5.** (3)	**6.** (4)	**7.** (3)	**8.** (3)
9. (2)	**10.** (1)	**11.** (3)	**12.** (3)	**13.** (3)	**14.** (3)	**15.** (4)	**16.** (4)
17. (3)	**18.** (1)	**19.** (2)	**20.** (4)	**21.** (5)	**22.** (392)	**23.** (8)	**24.** (30)
25. (750)	**26.** (2)	**27.** (14)	**28.** (1)	**29.** (400)	**30.** (15)	**31.** (4)	**32.** (1)
33. (1)	**34.** (1)	**35.** (1)	**36.** (3)	**37.** (2)	**38.** (1)	**39.** (2)	**40.** (2)
41. (3)	**42.** (4)	**43.** (2)	**44.** (3)	**45.** (4)	**46.** (3)	**47.** (1)	**48.** (2)
49. (4)	**50.** (1)	**51.** (25)	**52.** (2)	**53.** (3)	**54.** (2)	**55.** (5)	**56.** (22)
57. (87)	**58.** (2)	**59.** (8)	**60.** (3)	**61.** (4)	**62.** (2)	**63.** (2)	**64.** (2)
65. (4)	**66.** (2)	**67.** (3)	**68.** (4)	**69.** (2)	**70.** (4)	**71.** (1)	**72.** (3)
73. (1)	**74.** (2)	**75.** (4)	**76.** (1)	**77.** (2)	**78.** (4)	**79.** (2)	**80.** (1)
81. (6)	**82.** (17)	**83.** (12)	**84.** (57)	**85.** (99)	**86.** (5)	**87.** (9)	**88.** (13)
89. (104)	**90.** (56)						