IIT–JEE SCREENING EXAMINATION

PAST QUESTION PAPERS–2000

Time: 3 hours **Maximum Marks: 105**

Instructions:

A. General:

I. Write your Name and Registration No. at the bottom of this page.

II. The Question Paper has 105 questions. Each question carries one mark. There is no negative marking.

III. The answer sheet is a machine–gradable Objective Response Sheet (ORS). Handle it with care.

IV. The Question Paper contains blank spaces for rough work. No additional sheet will be provided for this purpose.

V. Blank papers, clip boards, log tables, slide rule, calculators, cellular phones, pagers and electronic gadgets, in any form, are not allowed.

B. Question Paper Code:

VI. A Question Paper Code is printed at the top right hand corner of this page. The same code is printed on the top left half as well as on the top right half of the ORS.

VII. If the codes on your Question Paper and ORS are not same, then exchange your ORS with an ORS having the same Question Paper Code from the invigilator.

VIII. Do not write answers on an ORS having a code different from the code printed on your Question Paper.

C. Filling in on the Right Half of the ORS:

IX. With a good quality HB pencil writer your Registration No. in the boxes provided and darken the appropriate bubble under each digit of your Registration No.

X. Write in ink your name, Registration No., Name of Centre, and put your signature in appropriate boxes on the ORS. Do not write these anywhere else on the ORS.

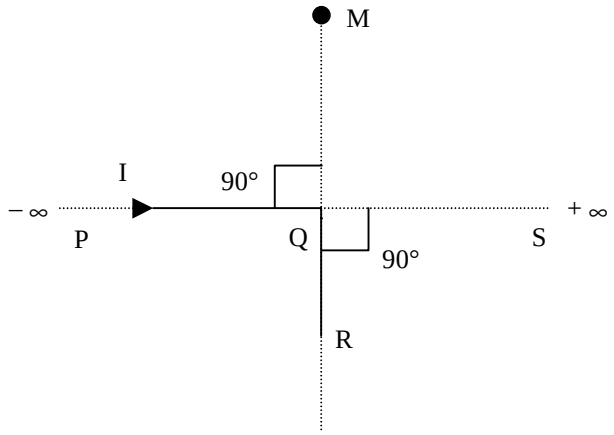
D. Answering on the Left Half of the ORS:

XI. Each question has four choices (A,B,C, and D) of which only one is the most appropriate answer. Select the same and darken the appropriate bubble (A or B or C or D) against the question number on the ORS using a good quality HB pencil only

XII. In case you wish to change an answer, erase the old answer completely using a good soft eraser, and then darken the finally chosen bubble.

Q1. An infinitely long conductor PQR is bent to form a right angle as shown. A current I flows through PQR. The magnetic field due to this current at the point M is H_1. Now, another infinitely long straight conductor QS is connected at Q so that the current is I/2 in QR as well as in QS, the current in PQ remaining unchanged. The magnetic field at M is now H_2. The ratio H_1 / H_2 is given by

(a) 1/2 (b) 1
(c) 2/3 (d) 2



Q2. A particle of charge q and mass m moves in a circular orbit of radius r with angular speed w. The ratio of the magnitude of its magnetic moment to that of its angular momentum depends on

(a) ω and q (b) ω, q and m
(c) q and m (d) ω and m

Q3. Two vibrating strings of the same material but lengths L and 2L have radii 2r and r respectively. They are stretched under the same tension. Both the strings vibrate in their fundamental modes, the one of length L with frequency v_1 and the other with frequency v_2. The ratio v_1 / v_2 is given by:

(a) 2 (b) 4
(c) 8 (d) 1

Q4. The dimension of (1/2) $\varepsilon_0 E^2$ (ε_0: permittivity of free space; E: electric field) is

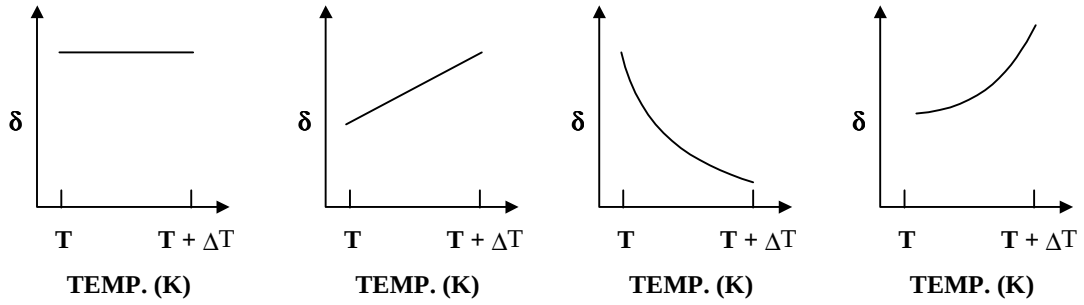
(a) $ML\,T^{-1}$ (b) $ML^2\,T^{-2}$
(c) MLT^{-2} (d) $ML^2\,T^{-1}$

Q5. Two monatomic ideal gases 1 and 2 of molecular masses m_1 and m_2 respectively are enclosed in separate containers kept at the same temperature. The ratio of the speed of sound in gas 1 to that of gas 2 is given by

(a) $\sqrt{\frac{m_1}{m_2}}$ (b) $\sqrt{\frac{m_2}{m_1}}$

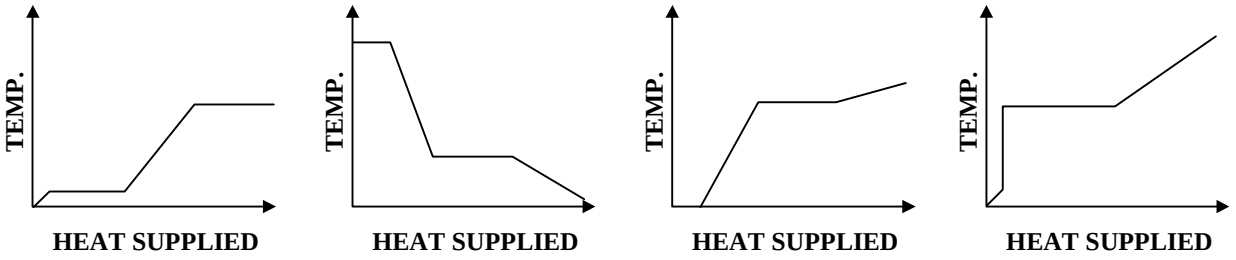
(c) $\frac{m_1}{m_2}$ (d) $\frac{m_2}{m_1}$

Q6. **An ideal gas is initially at temperature T and volume V. Its volume is increased by ΔV due to an increase in temperature ΔT, pressure remaining constant. The quantity $\delta = \Delta V/(V\Delta T)$ varies with temperature as**



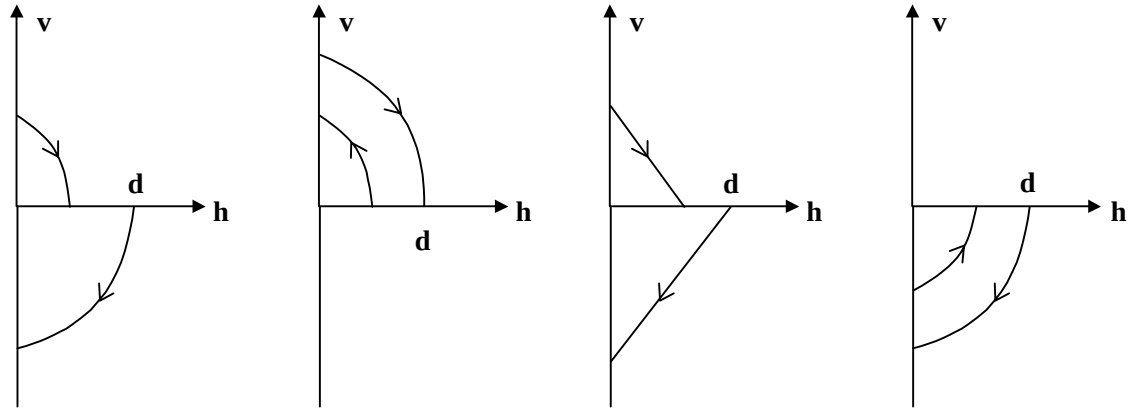
(A) **(B)** **(C)** **(D)**

Q7. **A block of ice at -10^0C is slowly heated and converted too steam at 100^0C. Which of following curves represents the phenomenon qualitatively?**



(A) **(B)** **(C)** **(D)**

Q8. **A ball is dropped vertically from a height d above the ground. It hits the ground and bounces up vertically to a height d/2. Neglecting subsequent motion and air resistance, its velocity v varies with the height h above the ground as**



(A) **(B)** **(C)** **(D)**

Q9. **A train moves towards a stationary observed with speed 34 m/s. The train sounds whistle and its frequency registered by the observer is f_1. If the train's speed is reduced to 17 m/s, the frequency registered is f_2. If the speed of sound is 340 m/s then the ratio f_1 / f_2 is**

(a) 18/19 (b) 1/2
(c) 2 (d) 19/18

Q10. A long horizontal rod has a bead, which can slide along its length, and initially placed at a distance L from one end A of the rod. The rod is set in angular motion about A with constant angular acceleration α. If the coefficient of friction between the rod and the bead is μ, the gravity is neglected, then the time after which the bead starts slipping is

(a) $\sqrt{\frac{\mu}{\alpha}}$ (b) $\frac{\mu}{\sqrt{\alpha}}$

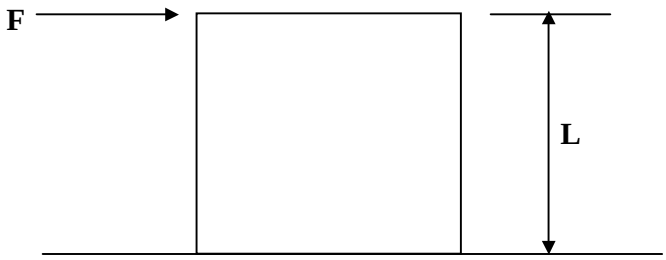
(c) $\frac{1}{\sqrt{\mu\alpha}}$ (d) infinitesimal

Q11. A monatomic ideal gas, initially at temperature T_1, is enclosed in a cylinder fitted with a frictionless piston. The gas is allowed to expand adiabatically to a temperature T_2 by releasing the piston suddenly. If L_1 and L_2 are the lengths of the gas column before and after expansion respectively, then T_1/T_2 is given by

(a) $\left(\frac{L_1}{L_2}\right)^{2/3}$ (b) $\frac{L_1}{L_2}$

(c) $\frac{L_2}{L_1}$ (d) $\left(\frac{L_2}{L_1}\right)^{2/3}$

Q12. A cubical block of side L rests on a rough horizontal surface with coefficient of friction μ. A horizontal force F is applied on the block as shown. If the coefficient of friction is sufficiently high so that the block does not slide before toppling, the minimum force required to topple the block is

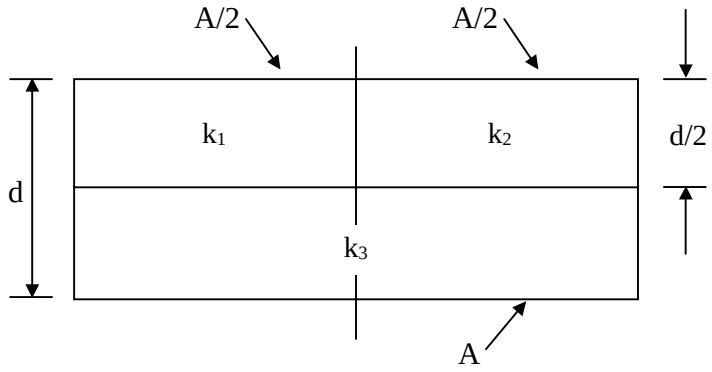


(a) infinitesimal (b) mg / 4
(c) mg / 2 (d) mg $(1 - \mu)$

Q13. Imagine an atom made up of a proton and a hypothetical particle of double the mass of the electron but having the same charge as the electron. Apply the Bohr atom model and consider all possible transactions of this hypothetical particle to the first excited level. The longest wavelength photon that will be emitted has wavelength λ (given in terms of the Rydberg constant R for the hydrogen atom) equal to

(a) 9 / (5R) (b) 36 / (5R)
(c) 18 / (5R) (d) 4 / R

Q14. A parallel plate capacitor of area A, plate separation d and capacitance C is filled with three different dielectric materials having dielectric constants k_1, k_2, k_3 as shown. If a single dielectric material is to be used to have the same capacitance C in this capacitor, then Its dielectric constant k is given by



A = area of plates

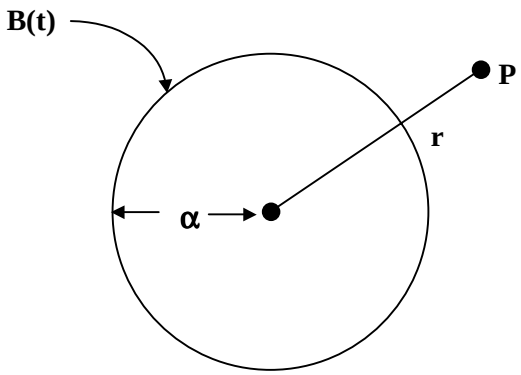
(a) $\frac{1}{k}=\frac{1}{k_1}+\frac{1}{k_2}+\frac{1}{2k_3}$

(b) $\frac{1}{k}=\frac{1}{k_1+k_2}+\frac{1}{2k_3}$

(c) $k=\frac{k_1k_2}{k_1+k_2}+2k_3$

(d) $k = k_1 + k_2 + 2k_3$

Q15. Uniform but time–varying magnetic field B(t) exists in a circular region of radius a and is directed into the plane of the paper, as shown. The magnitude of the induced electric field at point P at a distance r from the center of the circular region



(a) is zero

(b) decreases as 1/r

(c) increases as r.

(d) decreases as $1/r^2$

Q16. The electron in a hydrogen atom makes a transition from an excited state to the ground state. Which of the following statements is true?

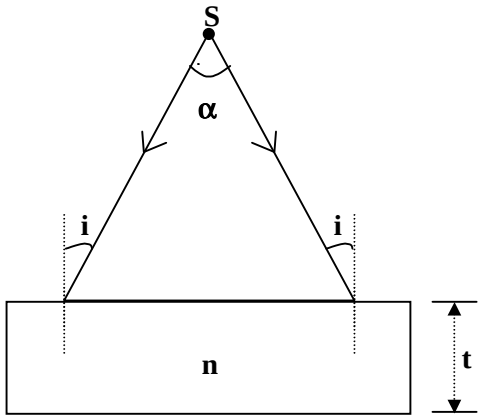
(a) Its kinetic energy increases and its potential and total energies decrease.

(b) Its kinetic energy decreases, potential energy increases and its total energy remains the same.

(c) Its kinetic and total energies decrease and its potential energy increases.

(d) Its kinetic, potential and total energies decrease.

Q17. A diverging beam of light from a point source S having divergence angle α, falls symmetrically on a glass slab as shown. The angles of incidence of the two extreme rays are equal. If the thickness of the glass slab is t and the refractive index n, then the divergence angle of the emergent beam is

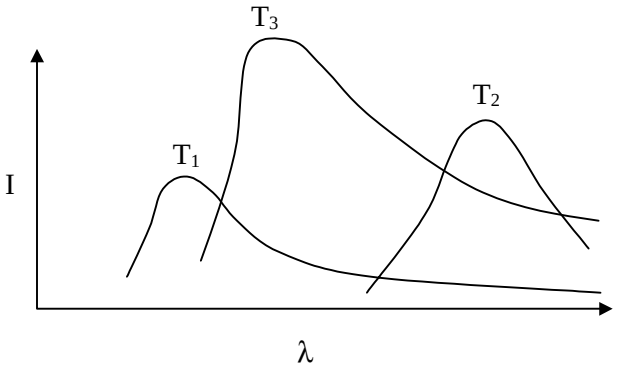


(a) zero
(b) α
(c) $\sin^{-1}(1/n)$
(d) $2\sin^{-1}(1/n)$

Q18. In a double slit experiment, instead of taking slits of equal widths, one slit is made twice as wide as the other. Then, in the interference pattern

(a) the intensities of both the maxima and the minima increase.
(b) the intensity of the maxima increases and the minima has zero intensity.
(c) the intensity of maxima decreases and the minima has zero intensity.
(d) the intensity of the maxima decreases and the minima has zero intensity.

Q19. The plot of intensity versus wavelength for three black bodies at temperature T_1, T_2, and T_3 respectively are as shown. Their temperatures are such that



(a) $T_1 > T_2 > T_3$
(b) $T_1 > T_3 > T_2$
(c) $T_2 > T_3 > T_1$
(d) $T_3 > T_2 > T_1$

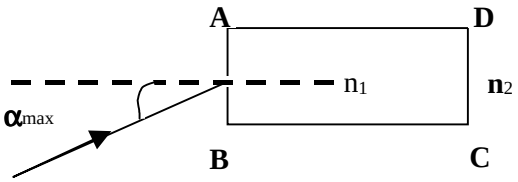
Q20. A hollow double concave lens is made up of very thin transparent material. It can be filled with air or either of two liquids L_1 and L_2 having refractive indices n_1 and n_2 respectively ($n_2 > n_1 > 1$). The lens will diverge a parallel beam of light if it is filled with

(a) air and placed in air.
(b) air and immersed in L_1
(c) L_1 and immersed in L_2
(d) L_2 and immersed in L_1

Q21. A coil of wire having finite inductance and resistance has a conducting ring placed coaxially within it. The coil is connected to a battery at time t = 0, so that a time depandent current $I_1(t)$ starts flowing through the coil. If $I_2(t)$ is the current induced in the ring, and B(t) is the magnetic field at the axis of the coil due to $I_1(t)$, then as a function of time (t > 0), the product $I_2(t)$ B(t)

(a) increases with time
(b) decreases with time
(c) does not vary with time.
(d) passes through a maximum.

Q22. A rectangular glass slab ABCD, of refractive index n_1, is immersed in water of refractive index n_2 ($n_1 > n_2$). A ray of light is incident at the surface AB of the slab as shown. The maximum value of the angle of incidence α_{max}, such that the ray comes out only from the other surface CD is given by



(a) $\sin^{-1}\left[\frac{n_1}{n_2}\cos\left(\sin^{-1}\frac{n_2}{n_1}\right)\right]$
(b) $\sin^{-1}\left[n_1\cos\left(\sin^{-1}\frac{1}{n_2}\right)\right]$
(c) $\sin^{-1}\left(\frac{n_1}{n_2}\right)$
(d) $\sin^{-1}\left(\frac{n_2}{n_1}\right)$

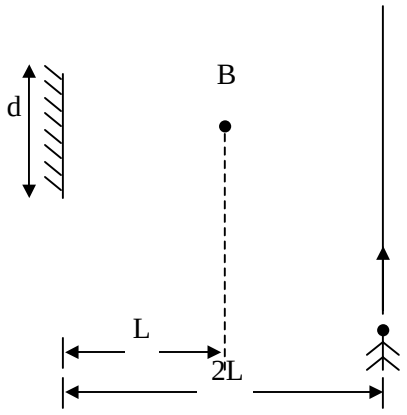
Q23. The period of oscillation of a simple pendulum of length L suspended from the roof of a vehicle which moves without friction down an inclined plane of inclination α, is given by

(a) $2\pi\sqrt{\frac{L}{g\cos\alpha}}$
(b) $2\pi\sqrt{\frac{L}{g\sin\alpha}}$
(c) $2\pi\sqrt{\frac{L}{g}}$
(d) $2\pi\sqrt{\frac{L}{g\tan\alpha}}$

Q24. Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2 in three different ways. The work done by the gas is W_1 if the process is purely isothermal, W_2 if purely isobaric and W_3 if purely adiabatic. Then

(a) $W_2 > W_1 > W_3$
(b) $W_2 > W_3 > W_1$
(c) $W_1 > W_2 > W_3$
(d) $W_1 > W_3 > W_2$

Q25. A point source of light B is placed at a distance L in front of the center of a mirror of width d hung vertically on a wall. A man walks in front of the mirror along a line parallel to the mirror at a distance 2L from it as shown. The greatest distance over which he can see the image of the light source in the mirror is



(a) d / 2 (b) d
(c) 2 d (d) 3 d

Q26. Two radioactive materials X_1 and X_2 have decay constants 10 λ and λ respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 to that of X_2 will be 1/e after a time

(a) 1 / (10 λ) (b) 1 / (11 λ)
(c) 11 / (10 λ) (d) 1 / (9 λ)

Q27. In a compound microscope, the intermediate image is

(a) virtual, erect and magnified (b) real, erect and magnified
(c) real, inverted and magnified. (d) virtual, erect and reduced.

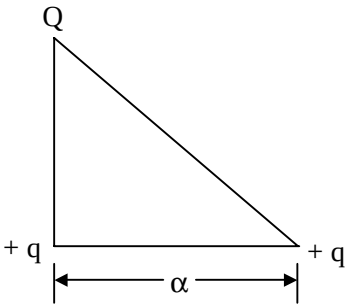
Q28. Electrons with energy 80 keV are incident on the tungsten target of an X–ray tube. K shell electrons of tungsten have –72.5 keV energy. X–rays emitted by the tube contain only

(a) a continuous X–ray spectrum (Bremsstrahlung) with a minimum wavelength of ~ 0.155 $\overset{o}{A}$.
(b) a continuous X–ray spectrum (Bremsstrahlung) with all wavelengths.
(c) the characteristic X–ray spectrum of tungsten.
(d) a continuous X–ray spectrum (Bremsstrahlung) with a minimum wavelength of ~ 0.155 $\overset{o}{A}$.

Q29. An ionized gas contains both positive and negative ions. If it is subjected simultaneously to an electric field along the +x direction and a magnetic field along the +z direction, then

(a) positive ions deflect towards +y direction and negative ions towards –y direction.
(b) all ions deflect towards +y direction.
(c) all ions deflect towards –y direction.
(d) positive ions deflect towards –y direction and negative ions towards +y direction.

Q30. Three charges Q, + q and + q are placed at the vertices of a right–angled isosceles triangle as shown. The net electrostatic energy of the configuration is zero if Q is equal to



(a) $\frac{-q}{1+\sqrt{2}}$ (b) $\frac{-2q}{2+\sqrt{2}}$

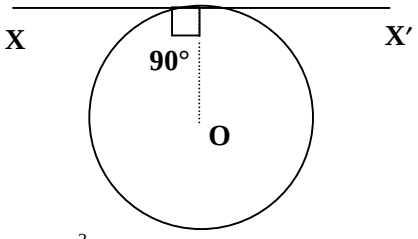
(c) –2q (d) +q

Q31. A wind–powered generator converts wind energy into electrical energy. Assume that the generator converts a fixed fraction of the wind energy intercepted by its blades into electrical energy. For wind speed v, the electrical power output will be proportional to

(a) v (b) v^2

(c) v^3 (d) v^4

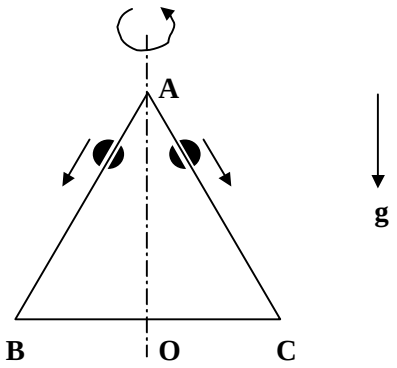
Q32. A thin wire of length L and uniform linear mass density p is bent into a circular loop with centre at O as shown. The moment of inertia of the loop about the axis XX' is



(a) $\frac{pL^3}{8\pi^2}$ (b) $\frac{pL^3}{16\pi^2}$

(c) $\frac{5pL^3}{16\pi^2}$ (d) $\frac{3pL^3}{8\pi^2}$

Q33. An equilateral triangle ABC formed from a uniform wire has two small identical beads initially located at A. The triangle is set rotating about the vertical axis AO. Then the beads are released from rest simultaneously and allowed to slide down, one along AB and the other along AC as shown. Neglecting frictional effects, the quantities that are conserved as the beads slide down, are



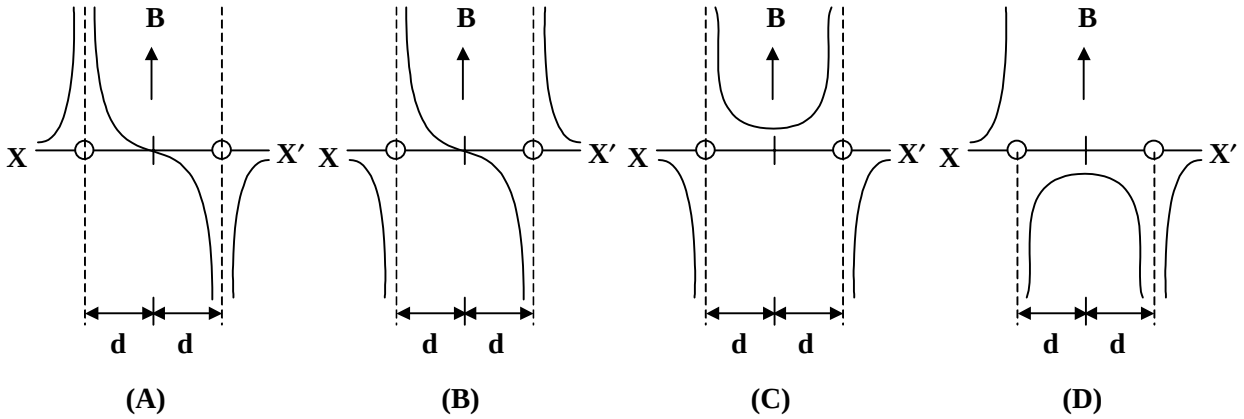
(a) angular velocity and total energy (kinetic and potential)
(b) total angular momentum and total energy.
(c) Angular velocity and moment of inertia about the axis of rotation.
(d) Total angular momentum and moment of inertia about the axis of rotation.

Q34. A large open tank has two holes in the wall. One is a square hole of side L at a depth y from the top and the other is a circular hole of radius R at a depth 4y from the top. When the tank is completely filled with water, the quantities of water flowing out per second from both holes are the same. Then, R is equal to

(a) $\frac{L}{\sqrt{2\pi}}$ (b) $2\pi L$

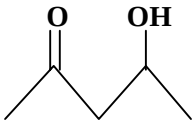
(c) L (d) $\frac{L}{2\pi}$

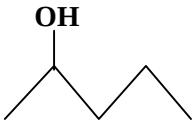
Q35. Two long parallel wires are at a distance 2d apart. They carry steady equal currents flowing out of the plane of the paper, as shown. The variation of the magnetic field B along the line XX' is given by

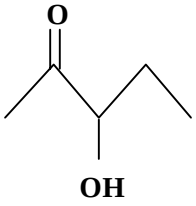


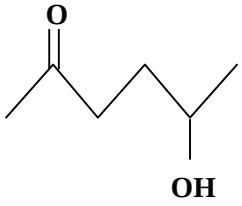
Gas constant, R = 0.082 L atm $k^{-1}mol^{-1}$ = 8.314 J $K^{-1}mol^{-1}$
Atomic Number: Be = 4; B = 5; C = 6; N = 7; O = 8; S = 16; Xe = 54
Atomic Mass: H = 1.008; O = 16.00; S = 32.07; Se = 78.96; Te = 127.6

Q36. Which one of the following will most readily be dehydrated in acidic condition?

(a) 

(b) 

(c) 

(d) 

Q37. The ΔH_f^0 for CO_2 (g), CO(g) and H_2O(g) are –393.5, –110.5 and –241.8 KJ mol^{-1} respectively. The standard enthalpy change (in KJ) for the reaction $CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$ is

(a) 524.1 (b) 41.2
(c) –262.5 (d) 41.2

Q38. Which of the following compounds will exhibit geometrical isomerism?

(a) 1–phenyl–2–butene (b) 3–phenyl–1–butene
(c) 2–phenyl–1–butene (d) 1,1–diphenyl–1–propene

Q39. For the reversible reaction, $N_2(g) + 3H_2(g) = 2NH_3(g)$ at 500^0C, the value of K_p 1.44×10^{-5} when partial pressure is measured in atmospheres. The corresponding value of K_c, with concentration in mole litre^{-1}, is

(a) $1.44 \times 10^{-5}/(0.082 \times 500)^{-2}$ (b) $1.44 \times 10^{-5}/(8.314 \times 773)^{-2}$
(c) $1.44 \times 10^{-5}/(0.082 \times 773)^{2}$ (d) $1.44 \times 10^{-5}/(0.082 \times 773)^{-2}$

Q40. Benzoyl chloride is prepared from benzoic acid by

(a) Cl_2, hv (b) SO_2Cl_2
(c) $SOCl_2$ (d) Cl_2, H_2O

Q41. For the electrochemical cell, $\frac{2303 \times 4771}{54} \times 10^{8}$ $E^\circ(M^+/M)$ = 0.44V and E° (X/X^-) = 0.33 V. From this data one can deduce that

(a) $M + X \rightarrow M^+ + X^-$ is the spontaneous reaction
(b) $M^+ + X^- \rightarrow M + X^-$ is the spontaneous reaction
(c) $E_{cell} = 0.77$ V
(d) $E_{cell} = -0.77$ V

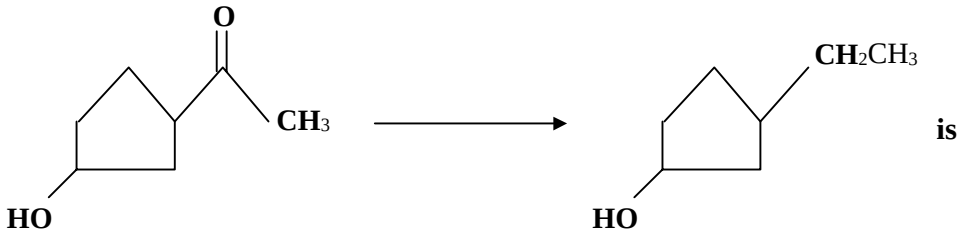
Q42. The correct order of radii is

(a) N < Be < B (b) $F^- < O^2 < N^{3-}$
(c) Na < Li < K (d) $Fe^{3+} < Fe^{2+} < Fe^{4+}$

Q43. The number of nodal planes in a p_x orbital is

(a) one (b) two
(c) three (d) zero

Q44. The appropriate reagent for the following transformation



is

(a) Zn (Hg), HCl (b) NH_2NH_2, OH^-
(c) H_2 / Ni (d) $NaBH_4$

Q45. Which of the following has the highest nucleophilicity?

(a) F^- (b) OH^-

(c) CH_3^- (d) NH_2^-

Q46. The rms velocity of hydrogen is $\sqrt{7}$ times the rms velocity of nitrogen. If T is the temperature of the gas,

(a) $T(H_2) = T(N_2)$ (b) $T(H_2) > T(N_2)$

(c) $T(H_2) < T(N_2)$ (d) $T(H_2) = \sqrt{7}\ T(N_2)$

Q47. The electronic configuration of an element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$. This represents its

(a) excited state (b) ground state

(c) cationic form (d) anionic state

Q48. The chemical processes in the production of steel from haematite ore involves

(a) reduction (b) oxidation

(c) reduction followed by oxidation (d) oxidation followed by reduction.

Q49. Amongst the following, identify the species with an atom in +6 oxidation state

(a) MnO_4^- (b) $Cr(CN)_6^{3-}$

(c) NiF_6^{2-} (d) CrO_2Cl_2

Q50. The compressibility of a gas is less than unity at STP. Therefore,

(a) $V_m > 22.4$ litres (b) $V_m < 22.4$ litres

(c) $V_m = 22.4$ litres (d) $V_m > 44.8$ litres

Q51. Among the following, the strongest base is

(a) $C_6H_5NH_2$ (b) $p - NO_2 - C_6H_4NH_2$

(c) $m - NO_2 - C_6H_4NH_2$ (d) $C_6H_5CH_2NH_2$

Q52. When two reactants, A and B are mixed to give products C & D, the reaction quotient, Q, at the initial stages of the reaction

(a) is zero (b) decreases with time

(c) is independent of time (d) increases with time

Q53. The rate constant for the reaction, $2N_2O_5 \rightarrow 4NO_2 + O_2$, is $3.0 \times 10^{-5} sec^{-1}$. If the rate is 2.40×10^{-5} mol litre $^{-1}sec^{-1}$, then the concentration of N_2O_5 (in mol litre^{-1}) is

(a) 1.4 (b) 1.2

(c) 0.04 (d) 0.8

Q54. Propyne and propene can be distinguished by

(a) conc. H_2SO_4 (b) Br_2 in CCl_4

(c) dil. $KmnO_4$ (d) $AgNO_3$ in ammonia

Q55. At 100^0C and 1 atm, if the density of liquid water is 1.0 g cm^{-3} and that of water vapor is 0.0006 g cm^{-3}, then the volume occupied by water molecules in 1 litre of steam at that temperature is

(a) 6 cm^3 (b) 60 cm^3

(c) 0.6 cm^3 (d) 0.06 cm^3

Q56. Electrolytic reduction of alumina to aluminium by Hall–Heroult process is carried out

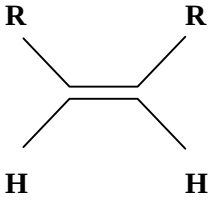
(a) in the presence of NaCl.
(b) in the presence of fluorite.
(c) in the presence of cryolite which forms a melt with lower melting temperature.
(d) in the presence of cryolite which forms a melt with higher melting temperature

Q57. The number of P–O–P bonds in cyclic metaphosphoric acid is

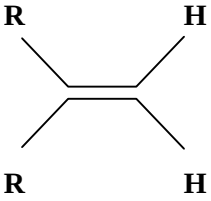
(a) zero
(b) two
(c) three
(d) four

Q58. Which one of the following alkenes will react fastest with H2 under catalytic hydrogenation condition?

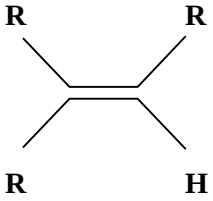
(a)



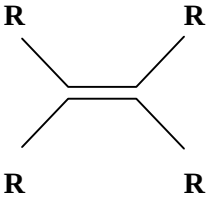
(b)



(c)



(d)



Q59. The order of reactivities of the following alkyl halides for a S_N2 reaction is

(a) RF > RCI > RBr > RI
(b) RF > RBr > RCI > RI
(c) RCI > RBr > RF > RI
(d) RI > RBr > RCI > RF

Q60. 60 Molecular shapes of SF4, CF4 and XeF4 are

(a) The same, with 2, 0 and 1 lone pairs of electrons respectively.
(b) The same, with 1, 1 and 1 lone pairs of electrons respectively.
(c) Different, with 0, 1 and 2 lone pairs of electrons respectively.
(d) Different, with 1, 0 and 2 lone pairs of electrons respectively.

Q61. The hybridization of atomic orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ are

(a) sp, sp^3 and sp^2 respectively.
(b) sp, sp^2 and sp^3 respectively
(c) sp^2, sp and sp^3 respectively.
(d) sp^2, sp^3 and sp respectively

Q62. Which of the following has the most acidic hydrogen?

(a) 3–Hexanone
(b) 2,4–hexanedione
(c) 2,5–hexanedione
(d) 2,3–hexanedione

Q63. The correct order of acidic strength is

(a) $Cl_2O_7 > SO_2 > P_4O_{10}$
(b) $CO_2 > N_2O_5 > SO_3$
(c) $Na_2O > MgO > AL_2O_3$
(d) $K_2O > CaO > MgO$

Q64. Ammonia can be dried by

(a) conc. H_2SO_4 (b) P_4O_{10}
(c) CaO (d) anhydrous $CaCl_2$

Q65. Amongst H_2O, H_2S, H_2Se and H_2Te, the one with the highest boiling point is

(a) H_2O because of hydrogen bonding.
(b) H_2Te because of higher molecular weight.
(c) H_2S because of hydrogen bonding.
(d) H_2Se because of lower molecular weight.

The questions below (66 to 70) consist of an 'Assertion' in column 1 and the 'Reason' in column 2. Use the following key to choose the appropriate answer.

(a) If both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
(b) If both assertion and reason are CORRECT, but reason is NOT the CORRECT explanation of the assertion.
(c) If assertion is CORRECT, but reason is INCORRECT.
(d) If assertion is INCORRECT but reason is CORRECT

	Assertion (column 1)	**Reason (column 2)**
Q66.	**The first ionization energy of Be is greater than that of B.**	**2p orbital is lower in energy than 2s.**
Q67.	**1–butene on reaction with HBr in the presence of a peroxide produces bromobutane.**	**It involves the formation of a primary radical.**
Q68.	**The heat absorbed during the isothermal expansion of an ideal gas vacuum is zero.**	**The volume occupied by the molecules of an ideal gas against is zero.**
Q69.	**The pressure of a fixed amount of an ideal gas is proportional to its temperature.**	**Frequency of collisions and their impact both increase in proportion to the square root of temperature.**
Q70.	**Phenol is more reactive than benzene towards electrophilic substitution reaction.**	**In the case of phenol, the intermediate carbocation is more resonance stabilized.**

Q71. Let $f(\theta) = \sin\theta(\sin\theta + \sin 3\theta)$. Then $f(\theta)$

(a) ≥ 0 only when $\theta \geq 0$ (b) ≤ 0 for all real θ
(c) $\geq$ for all real θ (d) ≤ 0 only when $\theta \leq 0$

Q72. If $x + y = k$ is normal to $y^2 = 12x$, then k is

(a) 3 (b) 9
(c) –9 (d) –3

Q73. **For $2 \le r \le n$, $\binom{n}{r}+2\binom{n}{r-1}+\binom{n}{r-2}=$**

(a) $\binom{n+1}{r+1}$ (b) $2\binom{n+1}{r+1}$

(c) $2\binom{n+2}{r}$ (d) $\binom{n+2}{r}$

Q74. **If α and β ($\alpha < \beta$), are the roots of the equation $x^2 + bx + c = 0$, where $c < 0 < b$, then**

(a) $0 < \alpha < \beta$ (b) $\alpha < 0 < \beta < |\alpha|$

(c) $\alpha < \beta < 0$ (d) $\alpha < 0 < |\alpha| < \beta$

Q75. **Let f: R $\rightarrow$ R be any function. Define g : R $\rightarrow$ R by g (x) = $|f(x)|$ for all x. Then g is**

(a) onto if f is onto (b) one–one if f is one–one.

(c) continuous if f is continuous. (d) Differentiable if f is differentiable.

Q76. **The domain of definition of the function y(x) given by the equation $2^x + 2^y = 2$ is**

(a) $0 < x \le 1$ (b) $0 \le x \le 1$

(c) $-\infty < x \le 0$ (d) $-\infty < x < 1$

Q77. **$x^2 + y^2 = 1$, then**

(a) $y\,y'' - 2\,(y')^2 + 1 = 0$ (b) $y\,y'' + (y')^2 + 1 = 0$

(c) $y\,y'' - (y')^2 - 1 = 0$ (d) $y\,y'' + 2\,(y')^2 + 1 = 0$

Q78. **If a, b, c, d are positive real numbers such that a + b + c + d = 2, then M= (a + b) (c + d) satisfies the relation**

(a) $0 \le M \le 1$ (b) $1 \le M \le 2$

(c) $2 \le M \le 3$ (d) $3 \le M \le 4$

Q79. **If the system of equations x – ky – z = 0, kx – y – z = 0, x + y – z = 0 has a nonzero solution, then the possible values of k are**

(a) –1, 2 (b) 1, 2

(c) 0, 1 (d) –1, 1

Q80. **The triangle PQR is inscribed in the circle $x^2 + y^2 = 25$. If Q and R have co–ordinates (3, 4) and (–4, 3) respectively, then $\angle$QPR is equal to**

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$

(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$

Q81. **In a triangle ABC, $2ac \sin \frac{1}{2}$ (A – B + C) =**

(a) $a^2 + b^2 - c^2$ (b) $c^2 + a^2 - b^2$

(c) $b^2 - c^2 - a^2$ (d) $c^2 - a^2 - b^2$

Q82. **For x ε R, $\lim_{x\to\infty}\left(\frac{x-3}{x+2}\right)^{x}$ = x → ∞**

(a) e
(b) e^{-1}
(c) e^{-5}
(d) e^{5}

Q83. **Consider an infinite geometric series with first term a and common ratio r. If its sum is 4 and the second term is $\frac{3}{4}$, then**

(a) a = $\frac{7}{4}$, r = $\frac{3}{7}$
(b) a = 2, r = $\frac{3}{8}$
(c) a = $\frac{3}{2}$, r = $\frac{1}{2}$
(d) a = 3, r = $\frac{1}{4}$

Q84. **Let g (x) = $\int_0^x f(t)dt$, where f is such that $\frac{1}{2}$ ≤ f (t) ≤ 1 for t ε [0, 1] and 0 ≤ f (t) ≤ $\frac{1}{2}$ for t ε (1, 2] Then g (2) satisfies the inequality,**

(a) $-\frac{3}{2} \le g(2) < \frac{1}{2}$
(b) $0 \le g(2) < 2$
(c) $\frac{3}{2} < g(2) \le \frac{5}{2}$
(d) $2 < g(2) < 4$

Q85. **In a triangle ABC, let ∠C = π/2. If r is the in radius and R is the circum radius of the triangle, then 2 (r + R) is equal to**

(a) a + b
(b) b + c
(c) c + a
(d) a + b + c

Q86. **How many different nine digit numbers can be formed from the number 223355888 by rearranging its digits so that the odd digits occupy even positions?**

(a) 16
(b) 36
(c) 60
(d) 180

Q87. **If arg (z) < 0, then arg (–z) –arg (z) =**

(a) π
(b) –π
(c) $-\frac{\pi}{2}$
(d) $\frac{\pi}{2}$

Q88. **Let PS be the median of the triangle with vertices P (2, 2), Q (6, –1) and R (7, 3). The equation of the line passing through (1, –1) and parallel to PS is**

(a) 2x – 9y – 7 = 0
(b) 2x – 9y – 11 = 0
(c) 2x + 9y – 11 + 0
(d) 2x + 9y + 7 = 0

Q89. **A pole stands vertically inside a triangular park ΔABC. If the angle of elevation of the top of the pole from each corner of the park is same, then in ΔABC the foot of the pole is at the**

(a) centroid
(b) circumcentre
(c) incentre
(d) orthocentre

Q90. **If f (x) =** $f(x)\begin{cases} e^{\cos x}\sin x & \text{for } |x| \le 2 \\ 2 & \text{otherwise,} \end{cases}$

then $\int_{-2}^{3} f(x)$ **dx =**

(a) 0 (b) 1
(c) 2 (d) 3

Q91. **The incentre of the triangle with vertices** $\left(1, \sqrt{3}\right)$**, (0, 0) and (2, 0) is**

(a) $\left(1, \frac{\sqrt{3}}{2}\right)$ (b) $\left(\frac{2}{3}, \frac{1}{\sqrt{3}}\right)$

(c) $\left(\frac{2}{3}, \frac{\sqrt{3}}{2}\right)$ (d) $\left(1, \frac{1}{\sqrt{3}}\right)$

Q92. **Consider the following statements:**

S: Both sin x and cos x are decreasing functions in the interval ($\pi/2$, π).
R: If a differentiable function decreases in an interval (a, b), then its derivative also decreases in (a, b) Which of the following is true?

(a) Both S and R are wrong
(b) Both S and R are correct, but R is not the correct explanation of S.
(c) S is correct and R is the correct explanation of S.
(d) S is the correct and R is wrong

Q93. **Let f(x) =** $\int e^x$ **(x – 1) (x – 2) dx. Then f decreases in the interval**

(a) $(-\infty, -2)$ (b) $(-2, -1)$
(c) (1, 2) (d) $(2, +\infty)$

Q94. **If the circles** $x^2 + y^2 + 2x + 2ky + 6 = 0$ **and** $x^2 + y^2 + 2ky + k = 0$ **intersect orthogonally, then k is**

(a) 2 or $-\frac{3}{2}$ (b) –2 or $-\frac{3}{2}$

(c) 2 or $\frac{3}{2}$ (d) –2 or $\frac{3}{2}$

Q95. **If the vectors** $\vec{a}, \vec{b}$ *and* $\vec{c}$ **form the sides BC, CA, and AB respectively, of a triangle ABC, then**

(a) $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a} = 0$

(b) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$

(c) $\vec{a}.\vec{b} = \vec{b}.\vec{c} = \vec{c}.\vec{a}$

(d) $\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} = \vec{0}$

Q96. If the normal to the curve y = f (x) at the point (3, 4) makes and angle 3 π/4 with the positive x–axis, then f′ (3) =

(a) –1 (b) $-\frac{3}{4}$

(c) $\frac{4}{3}$ (d) 1

Q97. Let the vectors $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ be such that $(\vec{a}\times\vec{b})\times(\vec{c}\times\vec{d}) = \vec{0}$. Let P_1 and P_2 be planes determined by the pairs of vectors $\vec{a}, \vec{b}$ and $\vec{c}, \vec{d}$ respectively. Then the angle between P_1 and P_2 is

(a) 0 (b) $\frac{\pi}{4}$

(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

Q98. Let f(x) = $\begin{Bmatrix} |x| & \text{for } 0 < |x| \le 2 \\ 1 & \text{for } x = 0 \end{Bmatrix}$ **Then at x = 0, f has**

(a) a local maximum (b) no local maximum.
(c) a local minimum (d) no extremum

Q99. If $\vec{a}, \vec{b}$ and $\vec{c}$ are unit coplanar vectors, then the scalar triple product $\left[2\vec{a}-\vec{b} \quad 2\vec{b}-\vec{c} \quad 2\vec{c}-\vec{a}\right] =$

(a) 0 (b) 1
(c) $-\sqrt{3}$ (d) $\sqrt{3}$

Q100. If b > a, then the equation (x – a) (x – b) – 1 = 0, has

(a) both roots in [a, b] (b) both roots in (–∞, a)
(c) both roots in (b, + ∞) (d) one root in (–∞, a) and other in (b, ∞)

Q101. If z_1, z_2, z_3 are complex numbers such that $|z_1| = |z_2| = |z_3| = \left|\frac{1}{z_1}+\frac{1}{z_2}+\frac{1}{z_3}\right| = 1$, then $|z_1 + z_2 + z_3|$ is

(a) equal to 1 (b) less than 1
(c) greater than 3 (d) equal to 3

Q102. For the equation $3x^2 + px + 3 = 0$, p > 0, if one of the roots is square of the other, then p is equal to

(a) 1/3 (b) 1
(c) 3 (d) 2/3

Q103. If the line x–1 = 0 is the directrix of the parabola $y^2 - kx + 8 = 0$, then one of the values of k is

(a) $\frac{1}{8}$ (b) 8

(c) 4 (d) $\frac{1}{4}$

Q104. For all x ε (0, 1)

(a) $e^x < 1 + x$ (b) $\log_e (1 + x) < x$

(c) $\sin x > x$ (d) $\log_e x > x$

Q105. The value of the integral $\int_{e^{-1}}^{e^2} \left| \frac{\log_e x}{x} \right| dx$ **is**

(a) $\frac{3}{2}$ (b) $\frac{5}{2}$

(c) 3 (d) 5