Instructions

Note: (i) The test is of 3 hours duration.

(ii) The test consists of 105 questions of 3 marks each. The maximum marks are 315.

(iii) There are three parts in the question paper. The distribution of marks subject wise in each part is as under for each correct response.

Part A − Chemistry (105 marks) − 35 Questions
Part B − Physics (105 marks) − 35 Questions
Part C − Mathematics (105 marks) − 35 Questions

(iv) Candidates will be awarded three marks each for indicated correct response of each question. One mark will be deducted for indicated incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the Answer Sheet.

CHEMISTRY

Q.1 The rate of diffusion of methane at a given temperature is twice that of a gas X. The molecular weight of gas X is :
(a) 64.0
(b) 32.0
(b) 4.0
(c) 8.0

Q.2 Which of the following electron transition in hydrogen atom will require the largest amount of energy?
(a) from n = 1, to n = 2
(b) from n = 2, to n = 3
(c) from n = ∞, to n = 1
(d) from n = 3, to n = 5

Q.3 In a gaseous reaction of the type aA + bB → cC + dD, which of the following statement is wrong?
(a) a litres of A combines with b litres of B to give C & D.
(b) a moles of A combines with b moles of B to give C & D.
(c) a g of A combines with b g of B to give C & D.
(d) a molecules of A combines with b molecules of B to give C & D.

Q.4 Which of the following molecule is planar?
(a) BCl_3
(b) $SOCl_2$
(c) NH_3
(d) NF_3

Q.5 The conductivity of a strong electrolyte
(a) increases on dilution.
(b) does not change considerably on dilution.
(c) decreases on dilution.
(d) depends upon density.

Q.6 What volume in litres of 0.1 M $KMnO_4$ is needed to oxidize 100 mg of FeC_2O_4 in acid solution ?
(a) 4.1
(b) 8.2
(c) 10.2
(d) 4.6

Q.7 The van't Hoff factor of a 0.005 M aqueous solution of KCl is 1.95. The degree of ionization of KCl is:
(a) 0.94
(b) 0.95
(c) 0.96
(d) 0.59

Q.8 On adding one ml solution of 10% NaCl to 10 ml gold solution in the presence of 0.25 gm of starch, the coagulation is just prevented. Therefore, the gold number of starch is:
(a) 0.25
(b) 2.5
(c) 250
(d) 0.025

Q.9 K for a zero order reaction is 2×10^{-2} mol litre^{-1} sec^{-1}. If the concentration of the reactant after 25 sec. is 0.5 M, the initial concentration must have been:
(a) 0.5 M (b) 1.25 M
(c) 12.5 M (d) 1.0 M

Q.10 Indicate the correct statement out of the following for the reaction

$NH_4Cl + H_2O \rightleftharpoons NH_4OH + HCl$ in water:
(a) The reaction is retarded by the addition of KOH.
(b) The reaction is favoured by the addition of NH_4OH.
(c) The reaction is retarded by the addition of hydrogen ion.
(d) None of these.

Q.11 The solubility of $BaSO_4$ in water is 0.00233 g per litre at 30^{o}C. The solubility of $BaSO_4$ in 0.1M $(NH_4)_2SO_4$ solution at the same temperature is:
(a) 10^{-5} mol litre^{-1}
(b) 10^{-6} mol litre^{-1}
(c) 10^{-8} mol litre^{-1}
(d) 10^{-9} mol litre^{-1}

Q.12 When a certain amount of ethylene was combusted, 6226 kJ heat was evolved. If heat of combustion of ethylene is 1411 kJ, the volume of O_2 (at NTP) that entered into the reaction is:
(a) 296.5 ml
(b) 296.5 litre
(c) 6226×22.4 litre
(d) 22.4 litre

Q.13 When an ion occupies an interstitial position in the crystal lattice, it is called :
(a) crystal defect
(b) Frenkel defect
(c) Schottky defect
(d) none

Q.14 In the system, $CaF_2(s) \rightleftharpoons Ca^{2+} + 2F^-$;increasing the concentration of Ca^{2+} four times will cause the equilibrium concentration of F^- to change to:
(a) ¼ of the initial value
(b) ½ of the initial value
(c) 2 times the initial value
(d) 4 times the initial value

Q.15 What is the number of hydrogen ions in 1 ml solution whose pH is 13?
(a) 10^{-13}
(b) 6.023×10^7
(c) 6.023×10^{10}
(d) 10^{13}

Q.16 The electronic configuration of the element which is just above the element with atomic number 43 in the same periodic group is:
(a) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^2$
(b) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^5$
(c) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6, 4s^1$
(d) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^1 4p^6$

Q.17 Permanent hardness of water can be removed by adding calgon $(NaPO_3)_n$. This is an example of :
(a) adsorption
(b) exchange of ion
(c) precipitation
(d) none

Q.18 Which of the following has the lowest thermal stability?
(a) Li_2CO_3
(b) Na_2CO_3
(c) K_2CO_3
(d) Rb_2CO_3

Q.19 Sodium thiosulphate is used in photography because of its:
(a) oxidizing behavior
(b) reducing behavior
(c) reaction with light

(d) complex forming behavior

Q.20 Which of the following is the anhydride of perchloric acid:
(a) Cl_2O
(b) ClO_2
(c) Cl_2O_6
(d) Cl_2O_7

Q.21 Fe^{2+} ion is distinguished from Fe^{3+} ion by:
(a) $BaCl_2$
(b) $AgNO_3$
(c) NH_4SCN
(d) $Pb(NO_3)_2$

Q.22 Identify the colourless transition metal ion.
(a) Zn^{2+}
(b) Ti^{4+}
(c) Cu^{+}
(d) All

Q.23 In which of the following complex the nickel metal is in its highest oxidation state?
(a) $Ni(CO)_4$
(b) K_2NiF_6
(c) $[Ni(NH_3)_6]BF_4)_2$
(d) $K_4[Ni(CN)_6]$

Q.24 Which of the following compounds may exhibit co-ordination isomerism?
(a) $[Cr(H_2O)_6]Cl_3$
(b) $[Cr(NH_3)_6][Co(CN)_6]$
(c) $[Cr(en)_2]NO_2$
(d) $[Ni(NH_3)_6][BF_4]_2$

Q.25 The number of optical active isomers of compound $CH_3CH(OH)COOH$ is:
(a) 2
(b) 3
(c) 4
(d) none

Q.26 The formation of cyanohydrins from a ketone is an example of :
(a) nucleophilic substitution
(b) electrophilic substitution
(c) electrophilic addition
(d) nucleophilic addition

Q.27 The reaction conditions leading to the best yields of C_2H_5Cl are:

(a) $C_2H_6 \text{ (excess)} + Cl_2 \xrightarrow[\text{light}]{UV}$

(b) $C_2H_6 + Cl_2 \xrightarrow[\text{room temp}]{dark}$

(c) $C_2H_6 + Cl_2 \text{ (excess)} \xrightarrow[\text{light}]{UV}$

(d) $C_2H_6 + Cl_2 \xrightarrow[\text{light}]{UV}$

Q.28 In the following sequence of reactions:

$$CH_3CH_2CH_2I \xrightarrow{KOH\ alc} (A) \xrightarrow{Br_2} (B) \xrightarrow{NaNH_2/NH_3} (C)$$

The end product (C) is:
(a) alkene
(b) alkanol
(c) alkyne
(d) alkyl amine

Q.29 Glycol condenses with ketones to give:
(a) cyclic acetals
(b) cyclic ketals
(c) acetaldehyde
(d) oxalic acid

Q.30 $$\begin{matrix} R \\ R \end{matrix}\!\!>\!C=O \xrightarrow{HCN} (A) \xrightarrow{NH_3} (B) \xrightarrow{Hydrolysis} (C)$$

Compound C in the above reaction is
(a) α - hydroxy acid
(b) α - amino acid
(c) α - amino alkanol
(d) α - amino β-hydroxy acid.

Q.31 $R—Mg—X \xrightarrow{CH_3CHO} (A) \xrightarrow{hydrolysis} (B)$
Compound B in the above sequence of reaction is:
(a) carboxylic acid
(b) primary alcohol
(c) secondary alcohol

(d) tertiary alcohol

Q.32 The reaction,

$RCOOAg + Br_2 \xrightarrow{CCl_4} RBr + AgBr + CO_2$

is called:

(a) HVZ reaction
(b) Hunsdicker reaction
(c) Hoffmann's reaction
(d) Carbylamine reaction

Q.33 Aryl halides are less reactive towards nucleophilic substitution reaction as compared to alkyl halides due to :

(a) the formation of less stable carbonium ion.
(b) resonance stabilization.
(c) longer carbon – halogen bond.
(d) inductive effect.

Q.34 What is the proper sequence of reagent in the Hoffmann's degradation reaction :

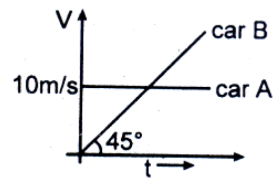
(a) Br_2, KOH, H_2O
(b) KOH, Br_2, H_2O
(c) H_2O, KOH, Br_2
(d) KOH, H_2O, Br_2

Q.35 Benzene sulphonic acid on treating with P_2O_5 gives :

(a) salicylic acid
(b) benzoic acid
(c) acid anhydride
(d) sodium benzoate

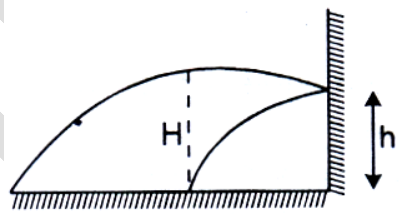
PHYSICS

Q.1 Initially car A is 10.5 m ahead of car B. Both start moving at time t = 0 in the same direction along a straight line. The velocity time graph of two cars is shown in figure. The time when the car B will catch the car A, will be



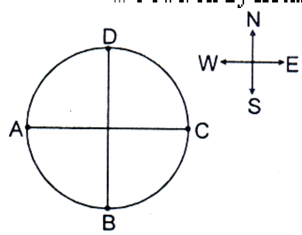
(a) t = 21 sec
(b) t = $2\sqrt{5}$ sec
(c) 20 sec
(d) None of these

Q.2 A stone is projected from a horizontal plane. It attains maximum height 'H' & strikes a stationary smooth wall & falls on the ground vertically below the maximum height. Assume the collision to be elastic, the height of the point on the wall where ball will strike is



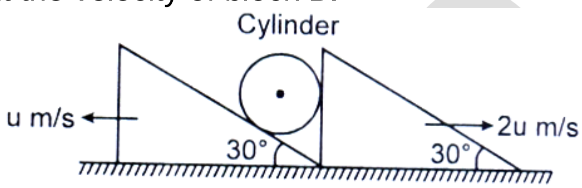
(a) $\frac{H}{2}$
(b) $\frac{H}{4}$
(c) $\frac{3H}{4}$
(d) None of these

Q.3 Two aeroplanes fly from their respective position 'A' and 'B' starting at the same time and reach the point 'C' (along straight line) simultaneously when wind was not blowing. On a windy day they head towards 'C' but both reach the point 'D' simultaneously in the same time which they took to reach 'C'. Then the wind is blowing in



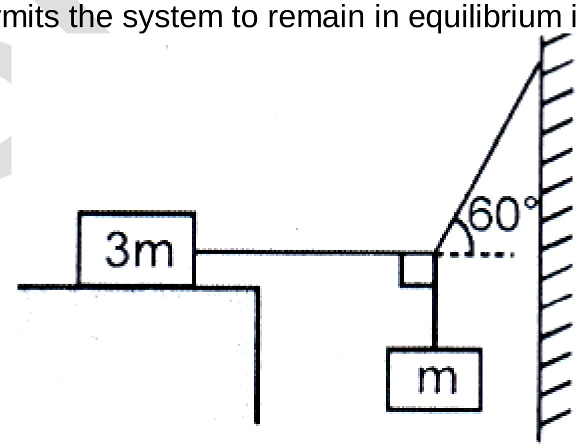
(a) North-East direction
(b) North-West direction
(c) Direction making an angle $0 < \theta < 90$ with North towards West
(d) North direction

Q.4 In the figure shown the velocity of lift is 2 m/s while string is winding on the motor shaft with velocity 2 m/s and block A is moving downwards with a velocity of 2 m/s, then find out the velocity of block B.



(a) $(M + m)\, g \tan\theta$
(b) $(M + m)\, g \cot\theta$
(c) $\frac{m}{M}(M + m)\, g \tan\theta$
(d) $\frac{m}{M}(M + m)\, g \cot\theta$

Q.5 A mass m is supported as shown in the figure by ideal strings connected to a rigid wall and to a mass 3m at rest on a fixed horizontal surface. The string connected to larger mass is horizontal, that connected to smaller mass is vertical and the one connected to wall makes an angle 60^{o} with horizontal. Then the minimum coefficient of static friction between the larger mass and the horizontal surface that permits the system to remain in equilibrium in the solution shown is:



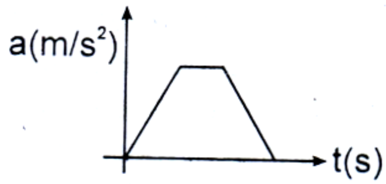
(a) $\frac{1}{\sqrt{3}}$

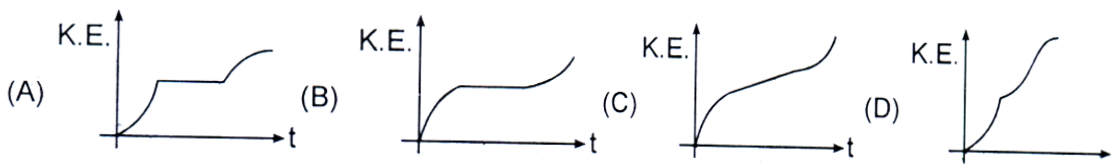
(b) $\frac{1}{3\sqrt{3}}$

(c) $\frac{\sqrt{3}}{2}$

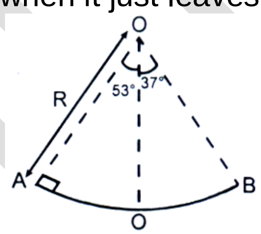
(d) $\sqrt{\frac{3}{2}}$

Q.6 For a particle moving on a straight line the variation of acceleration with time is given by the graph as shown. Initially the particle was at rest. Then the corresponding kinetic energy of the particle versus time graph will be





Q.7 A section of fixed smooth circle track of radius R in vertical plane is shown in the figure. A block is released from position A and leaves the track at B. The radius of curvature of its trajectory when it just leaves the track at B is:



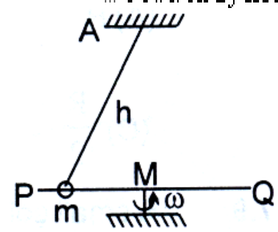
(a) R

(b) $\frac{R}{4}$

(c) $\frac{R}{2}$

(d) None of these

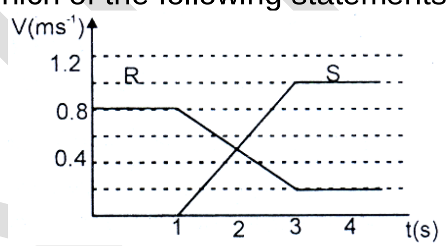
Q.8 A smooth rod PQ rotates in a horizontal plane about its midpoint M which is h = 0.1 m vertically below a fixed point A at a constant angular velocity 14 rad/s. A light elastic string of natural length 0.1 m requiring 1.47 N/cm has one end fixed at A and its other end attached to a ring of mass m = 0.3 kg which is free to slide along the rod. When the ring is stationary relative to rod, then find the inclination of string with vertical and the tension in string.



(a) cos θ = 3/5, T = 9.8 N
(b) θ = 60, T = 0
(c) cos θ = 2/5, T = 4.9 N
(d) θ = 30, T = 0

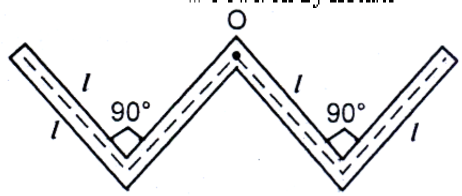
Q.9 A balloon having mass 'm' is filled with gas and is held in hands of a boy. Then suddenly it get released and gas starts coming out of it with a constant rate. The velocities of the ejected gases are also constant at 2 m/s with respect to the balloon. Find out the velocity of the balloon when the mass of gas is reduced to half.
(a) $\ell n\ 2$
(b) $2\ \ell n\ 4$
(c) $2\ \ell n\ 2$
(d) None of these

Q.10 The diagram shows the velocity – time graph for two masses R and S that collided elastically. Which of the following statements is true?



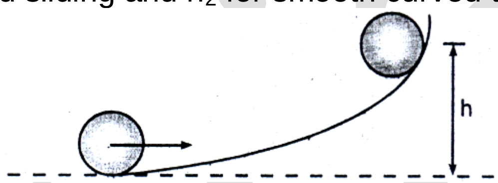
I. R and S moved in the same direction after the collision.
II. The velocities of R and S were equal at the mid time of the collision.
III. The mass of R was greater than mass of S.
(a) I only
(b) II only
(c) I and II only
(d) I, II and III

Q.11 A thin rod of length 4l, mass 4m is bent at the points as shown in the fig. What is the moment of inertia of the rod about the axis passing point O & perpendicular to the plane of the paper?



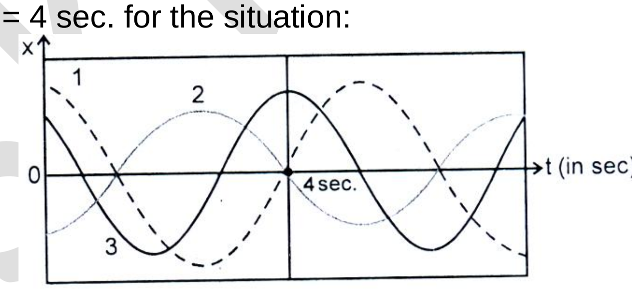
(a) $\frac{m\ell^2}{3}$
(b) $\frac{10m\ell^2}{3}$
(c) $\frac{m\ell^2}{12}$
(d) $\frac{m\ell^2}{24}$

Q.12 In the figure shown a ball rolls without sliding on a horizontal surface. It ascends a curved track up to height h and returns. Value of h is h_1 for sufficiently rough curved track to avoid sliding and h_2 for smooth curved track, then :



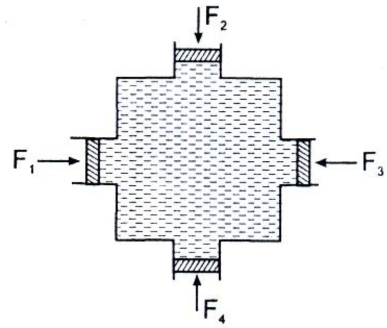
(a) $h_1 = h_2$
(b) $h_1 < h_2$
(c) $h_1 > h_2$
(d) $h_2 = 2h_1$

Q.13 Graph shows the x(t) curves for three experiments involving a particular spring-block system oscillating in SHM. The kinetic energy of the system is maximum at t = 4 sec. for the situation:



(a) 1
(b) 2
(c) 3
(d) same in all

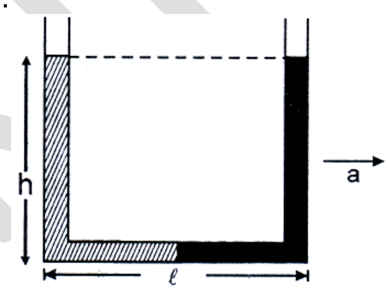
Q.14 In the figure shown water is filled in a symmetrical container. Four pistons of equal area A are used at the four opening to keep the water in equilibrium. Now an additional force F is applied at each piston. The increase in the pressure at the centre of the container due to this addition is



(a) $\frac{F}{A}$ (b) $\frac{2F}{A}$
(c) $\frac{4F}{A}$ (d) 0

Q.15 An open tank 10m long and 2m deep is filled up to 1.5 m height with oil of specific gravity 0.82. The tank is uniformly accelerated along its length from rest to a speed of 20 m/sec horizontally. The shortest time in which the speed may be attained without spilling any oil is: [g = 10 m/sec^2]
(a) 20 sec
(b) 18 sec
(c) 10 sec
(d) 5 sec

Q.16 A U-tube of base length "ℓ" filled with same volume of two liquids of densities ρ and 2ρ is moving with an acceleration 'a' on the horizontal plane. If the height difference between the two surfaces (open to atmosphere) becomes zero, then the height h is given by:



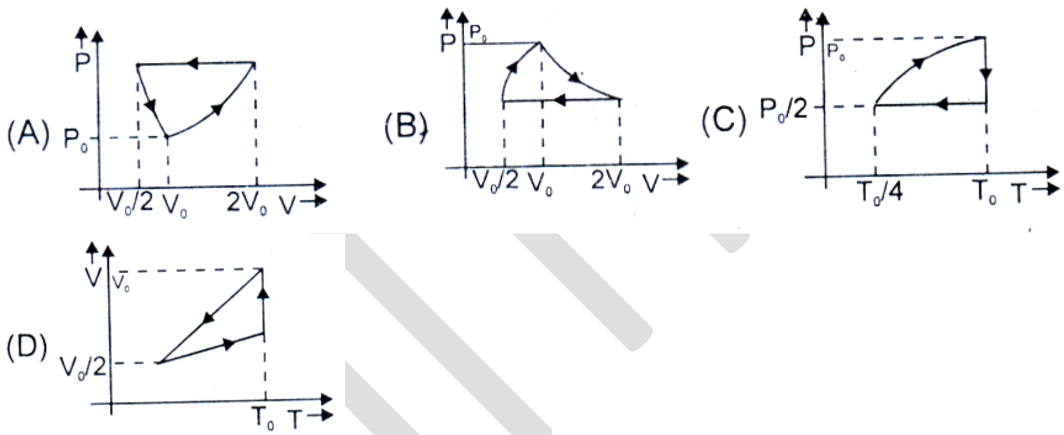
(a) $\frac{a}{2g}\ell$
(b) $\frac{3a}{2g}\ell$
(c) $\frac{a}{g}\ell$
(d) $\frac{2a}{3g}\ell$

Q.17 The coefficient is viscosity η of a liquid is defined as the tangential force on a layer in that liquid per unit area per unit velocity gradient across it. Then a sphere

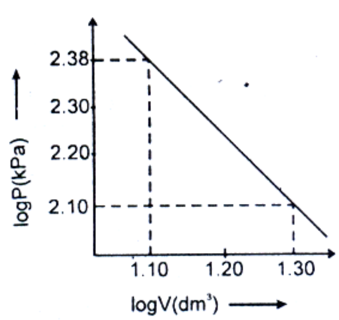
of radius 'a', moving through it under a constant force F attains a constant velocity 'V' given by:
(where K is a numerical constant)

(a) K F a η
(b) $K \frac{F}{a} \eta$
(c) $K \frac{F}{a\eta}$
(d) $K\eta \frac{a}{F}$

Q.18 One mole of an ideal gas at pressure P_0 and temperature T_0 is expanded isothermally to twice its volume and then compressed at constant pressure to $(V_0/2)$ and the gas is brought back to original state by a process in which P α V (Pressure is directly proportional to volume). The correct representation of process is

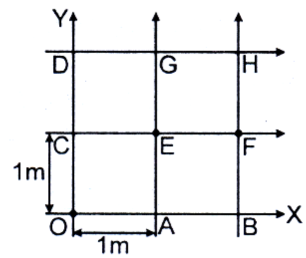


Q.19 Logarithms of readings of pressure and volume for an ideal gas were plotted on a graph as shown in figure. By measuring the gradient, it can be shown that the gas may be



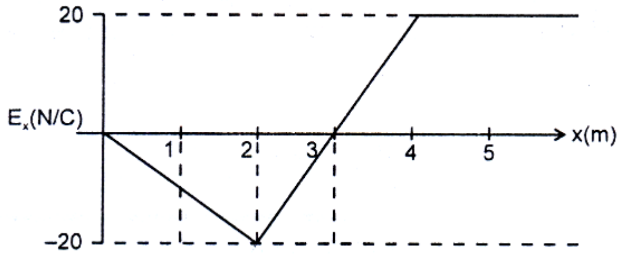
(a) monoatomic and undergoing an adiabatic change.
(b) monoatomic and undergoing an isothermal change.
(c) diatomic and undergoing an adiabatic change.
(d) triatomic and undergoing an isothermal change.

Q.20 The grid (each square of 1m × 1m), represents a region in space containing a uniform electric field. If potentials at point O, A, B, C, D, E, F & G, H are respectively 0, –1, –2, 1, 2, 0, –1, 1, and 0 volts, find the electric field intensity.



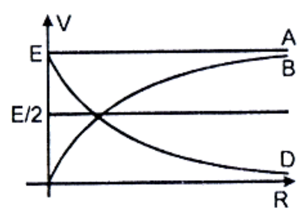
(a) $(\hat{\imath} + \hat{\jmath})$V/m
(b) $(\hat{\imath} - \hat{\jmath})$V/m
(c) $(-\hat{\imath} + \hat{\jmath})$V/m
(d) $(-\hat{\imath} - \hat{\jmath})$V/m

Q.21 A graph of the x component of the electric field as a function of x in a region of space is shown. The Y and Z components of the electric field are zero in this region. If the electric potential is 10 V at the origin, the potential at x = 2.0 m is:



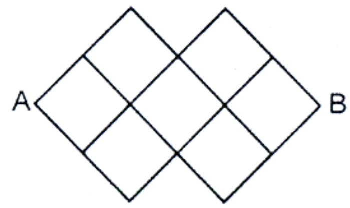
(a) 10V
(b) 40V
(c) –10V
(d) 30V

Q.22 A cell of emf E having an internal resistance 'r' is connected to an external resistance R. The potential difference 'v' across the resistance R varies with R as shown by the curve:



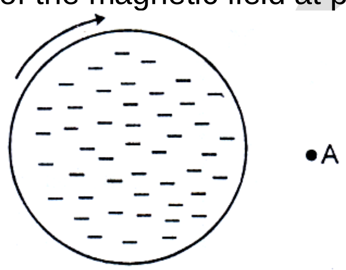
(a) A
(b) B
(c) C
(d) D

Q.23 In the shown wire frame, each side of a square (the smallest square) has a resistance R. The equivalent resistance of the circuit between the points A and B is:



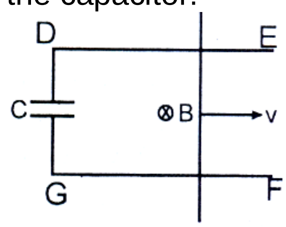
(a) R (b) 2R
(c) 4R (d) 8R

Q.24 The negatively and uniformly charged nonconducting disc as shown is rotated clockwise. The direction of the magnetic field at point A in the plane of the disc is:



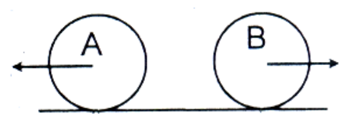
(a) into the page
(b) out of the page
(c) up the page
(d) down the page

Q.25 In the figure shown the section EDFG is fixed. A rod having resistance 'R' is moved with constant velocity in a uniform magnetic field B as shown in the figure. DE & FG are smooth and have negligible resistance. Initially capacitor is uncharged. The charge on the capacitor:



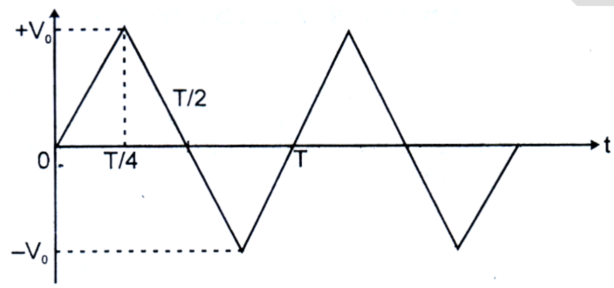
(a) remains constant
(b) increases exponentially with time
(c) increases linearly with time
(d) oscillates

Q.26 Two identical conducing rings A & B of radius R are in pure rolling over a horizontal conducting plane with same speed (of centre of mass)υ but in opposite direction. A constant magnetic field B is present pointing inside the plane of paper. Then the potential difference between the highest points of the two rings, is:



(a) zero
(b) 2 Bvr
(c) 4Bvr
(d) None of these

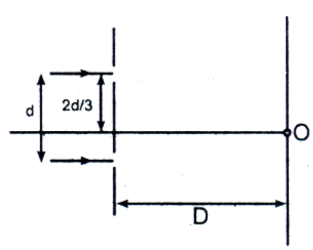
Q.27 The voltage time (V – t) graph for triangular wave having peak value. V_0 is as shown in figure.



The rms value of V in time interval from t = 0 to $\frac{T}{4}$ is:

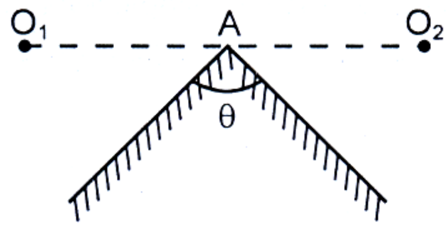
(a) $\frac{V_0}{\sqrt{3}}$
(b) $\frac{V_0}{2}$
(c) $\frac{V_0}{\sqrt{2}}$
(d) None of these

Q.28 In the figure shown if a parallel beam of white light is incident on the plane of the slits then the distance of the nearest white spot on the screen from O is: [assume d << D, λ << d]



(a) 0
(b) d/2
(c) d/3
(d) d/6

Q.29 Two plane mirrors are joined together as shown in figure. Two points objects O_1 and O_2 are placed symmetrically such that AO_1 and AO_2. The image of the two objects is common if:



(a) $\theta = 60^o$ $\theta = 90^o$
(b) $\theta = 30^o$ $\theta = 45^o$

Q.30 The angular momentum of an electron in first orbit of Li^{++} ion is:
(a) $\frac{3h}{2\pi}$
(b) $\frac{9h}{2\pi}$
(c) $\frac{h}{2\pi}$
(d) $\frac{h}{6\pi}$

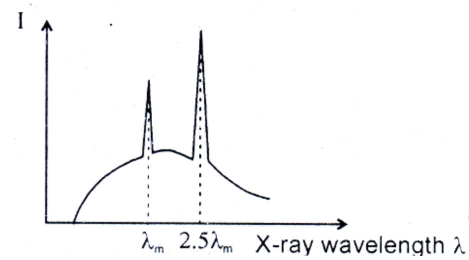
Q.31 In which of the following process the number of protons in the nucleus increases.
(a) α - decay
(b) β^- – decay
(c) β^+ – decay
(d) k – capture

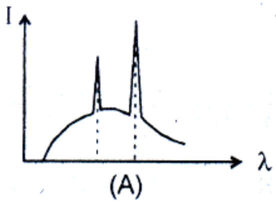
Q.32 In a photoelectric experiment, with light of wavelength 'λ', the fastest electron has speed v. If the exciting wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electron will become –
(a) $v\sqrt{\frac{3}{4}}$
(b) $v\sqrt{\frac{4}{3}}$
(c) less than $v\sqrt{\frac{3}{4}}$
(d) greater than $v\sqrt{\frac{4}{3}}$

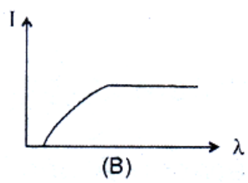
Q.33 1.5 mW of 400 nm light is directed at a photoelectric cell. If 0.10% of the incident photons produce photoelectrons, the current in the cell is –
(a) 0.36 μA
(b) 0.48 μA

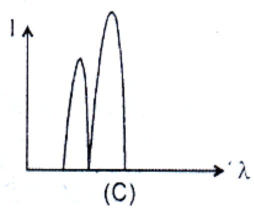
(c) 0.42 mA
(d) 0.32 mA

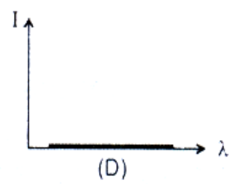
Q.34 When an electron accelerated by potential difference U is bombarded on a specific metal, the emitted X-ray spectrum obtained is shown in adjoining graph. If the potential difference is reduced to U/3, the correct spectrum is –



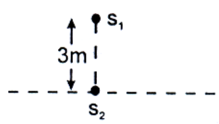
(A)


(B)


(C)


(D)


Q.35 S_1 & S_2 are two coherent sources of sound having no initial phase difference. The velocity of sound is 330 m/s. No minima will be formed on the line passing through S_2 and perpendicular to the line joining S_1 and S_2, if the frequency of both the sources is:



(a) 50 Hz
(b) 60 Hz
(c) 70 Hz
(d) 80 Hz

MATHEMATICS

Q.1 If a > 0, and the equation $|z - a^2| + |z - 2a| = 3$ represent an ellipse, then a lies in
(a) (1, 3)
(b) $(\sqrt{2}, \sqrt{3})$
(c) (0, 3)
(d) $(1, \sqrt{3})$

Q.2 If $\left|z - \frac{4}{2}\right| = 2$, then the greatest value of $|z|$ is
(a) $1 + \sqrt{2}$
(b) $2 + \sqrt{2}$
(c) $\sqrt{3} + 1$
(d) $\sqrt{5} + 1$

Q.3 The value of 'a', for which the quadratic equation $3x^2 + 2(a^2 + 1)x + (a^1 - 3a + 2)$ =0 possesses roots of opposite signs, lies in
(a) $(-\infty, 1)$
(b) $(-\infty, 0)$
(c) (1, 2)
(d) $\left(\frac{3}{2}, 2\right)$

Q.4 If $x \in R$, the number of solutions of $\sqrt{2+1} - \sqrt{2x-1}$ =1 is
(a) 1
(b) 2
(c) 4
(d) infinite

Q.5 If 1, $\log_y x$, $\log_z y$ and $-15 \log_x z$ are in A.P., then
(a) $z^3 = x$
(b) $x = y^2$
(c) $z-2 = y$
(d) None of these

Q.6 The sum of S_n to n terms of the series $\frac{1}{2} + \frac{3}{4} + \frac{7}{8} + \frac{15}{16} + \cdots$ is equal to
(a) $2^n - n - 1$
(b) $1 - 2^{-n}$
(c) $2^{-n} + n - 1$
(d) $2n - 1$.

Q.7 The number of solutions of $\log_4(x-1) = \log_2(x-3)$ is
(a) 3
(b) 1
(c) 2
(d) 0

Q.8 The number of ways of dividing 15 men and 15 women into 15 couples, each consisting of a man and a woman, is
(a) 1240
(b) 1840
(c) 1820
(d) 2005

Q.9 Four dice are rolled. The number of possible outcomes in which at least one die shows 2 is
(a) 1296
(b) 625
(c) 671
(d) None of these

Q.10 If sum of the coefficients of the first, second and third terms of the expansion of $\left(x^2+\frac{1}{x}\right)^m$ is 46, then the coefficient of the term that does not contain x is
(a) 84
(b) 92
(c) 98
(d) 106

Q.11 The value of x for which the matrix

$$A = \begin{bmatrix} 2 & 0 & 7 \\ 0 & 1 & 0 \\ 1 & -2 & 1 \end{bmatrix} \text{ is inverse of}$$

$$B = \begin{bmatrix} -x & 14x & 7x \\ 0 & 1 & 0 \\ x & -4x & -2x \end{bmatrix} \text{ is}$$

(a) $\frac{1}{2}$
(b) $\frac{1}{3}$
(c) $\frac{1}{4}$
(d) $\frac{1}{5}$

Q.12 If $f(\theta) = \begin{vmatrix} \cos^2\theta & \cos\theta\sin\theta & -\sin\theta \\ \cos\theta\sin\theta & \sin^2\theta & \cos\theta \\ \sin\theta & -\cos\theta & 0 \end{vmatrix}$, then value of $f(2\pi/3)$ is

(a) 1
(b) –1
(c) 2/3
(d) $-\sqrt{3}/2$

Q.13 Let w = $-\frac{1}{2}+\frac{i\sqrt{3}}{2}$. Then the value of the determinant $\Delta=\begin{vmatrix} 1 & 1 & 1 \\ 1 & -1-w^2 & w^2 \\ 1 & w^2 & w^4 \end{vmatrix}$ is

(a) 3w
(b) 3w (w – 1)
(c) $3w^2$
(d) 3w (1 – w)

Q.14 If a, b, c, > 0, the minimum value of $\frac{a}{b+c}+\frac{b}{c+a}+\frac{c}{a+b}$ is

(a) 1
(b) 3/2
(c) 2
(d) 5/2

Q.15 A fair coin is tossed 100 times. The probability of getting tails an odd number of times is

(a) ½
(b) 1/8
(c) 3/8
(d) None of these

Q.16 A man is known to speak the truth 3 out of 4 times. He throws a die and reports that it is a six. The probability that it is actually a six is

(a) 3/8
(b) 1/5
(c) ¾
(d) None of these

Q.17 A letter is known to have come from either TATANAGAR or CALCUTTA. On the envelope, just two consecutive letters, TA, are visible. The probability that the letter has come from CALCUTTA is

(a) 4/11
(b) 1/3
(c) 5/12
(d) None of these

Q.18 If $\sin x + \sin^2 x = 1$, then the value of $\cos^{12} x + 3 \cos^{10} x + 3 \cos^8 x + \cos^6 x - 1$ is equal to

(a) 0
(b) 1
(c) –1
(d) 2

Q.19 In a triangle, if the sum of two sides is x and their product is y such that $(x+z)(x-z) = y$ where z is the third side of the triangle then the triangle is

(a) equilateral
(b) right angled
(c) obtuse angled
(d) None of these

Q.20 The number of solutions of the equation $\sin 5x \cos 3x = \sin 6x \cos 2x$ in the interval $[0, \pi]$ are

(a) 3
(b) 4
(c) 5
(d) 6

Q.21 The value of $\cos\left(\frac{1}{2}\cos^{-1}\frac{1}{8}\right)$ is equal to

(a) ¾
(b) –3/4
(c) 1/16
(d) ¼

Q.22 If the circumcentre of a triangle lies at the origin and the centroid is the middle point of the line joining the point $(a^2 + 1, a^2 + 1)$ and $(2a, -2a)$; then the orthocenter lies on the line

(a) $y = (a^2 + 1)x$
(b) $y = 2ax$
(c) $x + y = 0$
(d) $(a-1)^2 x - (a + 1)^2 y = 0$

Q.23 The number of points (p, q) such that $p, q \in \{1, 2, 3, 4, 5\}$ and the equation $px^2 + qx + 1 = 0$ has real roots is

(a) 7
(b) 8
(c) 9
(d) none of these

Q.24 A variable chord is drawn through the origin to the circle $x^2 + y^2 - 2ax = 0$. The locus of the centre of the circle drawn on this chord as diameter is
(a) $x^2 + y^2 + ax = 0$
(b) $x^2 + y^2 + ay = 0$
(c) $x^2 + y^2 - ax = 0$
(d) $x^2 + y^2 - ay = 0$

Q.25 The line $x + y = 6$ is a normal to the parabola $y^2 = 8x$ at the point
(a) (18, –12)
(b) (4, 2)
(c) (2, 4)
(d) (3, 3)

Q.26 Equation of the plane through (3, 4, –1) which is parallel to the plane r. (2i – 3j + 56) = 0 is
(a) r . (2i – 3j + 5k) + 11 = 0
(b) r . (3i – 4j + k) + 11 = 0
(c) r . (3i + 4j – k) + 7 = 0
(d) r . (2i + 3j + 5k) + 7 = 0

Q.27 If a and b are two unit vectors, then the vector (a + b) × (a × b) is parallel to the vector
(a) a – b
(b) a + b
(c) 2a – b
(d) 2a + b

Q.28 The value of $\lim_{x\to 2}\frac{(x^2-x-6)^2}{(x+2)^2}$ is
(a) 6
(b) 25
(c) 9
(d) 16

Q.29 The number of points at which the function f(x) = 1/log|x| is discontinuous is
(a) 1
(b) 2
(c) 3
(d) 4

Q.30 If f(2) = 4 and f′(2) = 1, then $\lim_{x\to 2}\frac{xf(2)-2f(x)}{x-2}$ is equal to
(a) 2
(b) –2
(c) 1

(d) 3

Q.31 If G(x) = $-\sqrt{25-x^2}$, then $\lim_{x\to 1}\frac{G(x)-G(1)}{x-1}$ has the value

(a) 1/24
(b) 1/5
(c) $-\sqrt{24}$
(d) None of these

Q.32 If the normal to the curve y = f(x) at the point (3, 4) makes an angle $3\pi/4$ with the positive x-axis, then f'(3) is equal to

(a) –1
(b) –3/4
(c) 4/3
(d) 1

Q.33 If $I = \int \frac{dx}{\sqrt{(1-x)(x-2)}}$, then I equals

(a) $\sin^{-1}(2x-3) + C$
(b) $\sin^{-1}(2x+5) + C$
(c) $\sin^{-1}(3-2x) + C$
(d) $\sin^{-1}(5-2x) + C$

Q.34 If $I = \int_3^5 \frac{\sqrt{x}}{\sqrt{8-x}+\sqrt{x}}$ dx then I equals

(a) 1
(b) 2
(c) 3
(d) 3.5

Q.35 The order of the differential equation of all tangent lines to the parabola $y = x^2$ is

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