Competishun

52/6, Opposite Metro Mas Hospital, Shipra Path, Mansarovar

Date: 28/12/2023

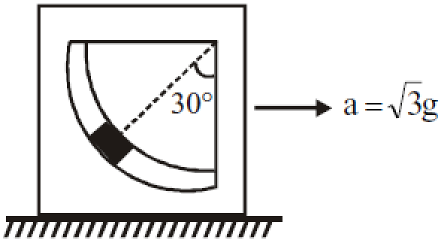
Time: 3 hours **Max. Marks:** 300

MFST-8 (23-24)

Physics

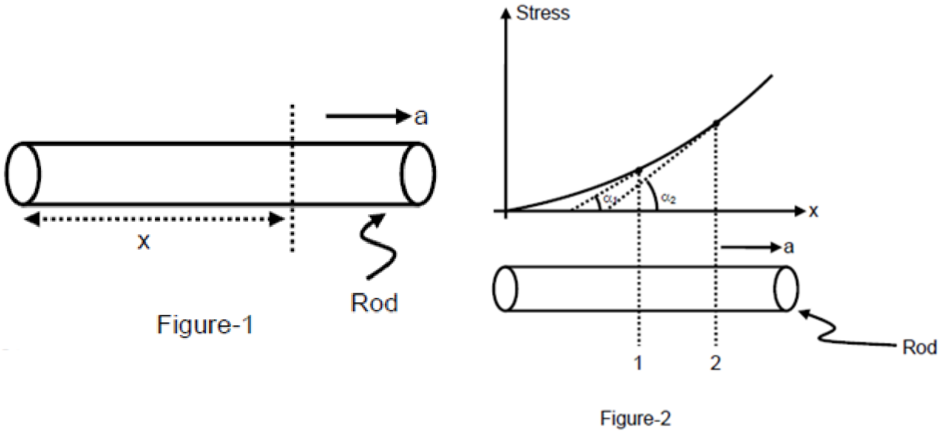
Single Choice Question

Q1 A Wedge with a rough groove in the shape of a quarter of a circle is kept on a smooth table (see figure). A disc is placed in the groove with a small clearance. Friction exists between groove and disc. The wedge is moved with an acceleration $\sqrt{3}g$. If disc is to remain stationary relative to groove at the position shown, the coefficient of friction required can be.



a) $\frac{1}{3}$ **b)** $\frac{1}{4}$ **c)** $\frac{1}{5}$ **d)** $\frac{9}{10}$

Q2 The rod of constant cross section area but having different density of material along its length is moving with constant acceleration in horizontal direction (Figure-1). Stress verses distance x from left end of rod graph is shown (Figure-2). At two sections 1 & 2 angle of tangent in stress verses x graph are $\alpha_1 = 37^o$ and $\alpha_2 = 53^o$. If density of rod at section-1 is 9 gm/cm^3 then find the density of rod at section-2 in gm/cm^3.



a) 12 **b)** 16 **c)** 2 **d)** 24

Q3 In a stack of three polarizing sheets the first and third are crossed while the middle one has its axis at 45° to the axes of the other two. The fraction of the intensity of an incident unpolarized beam of light that is transmitted by the stack is

a) 1/2 **b)** 1/3 **c)** 1/4 **d)** 1/8

Q4 Two uniform solid spheres A and B of same material, painted completely black and placed in free space separately where no radiation is incident on spheres. Their radii are R and 2R respectively and the dominating wavelengths (wavelength corresponding to which spectral emissive power is maximum) in their spectrum are observed to be in the ratio 1 : 2. Which of the following is **not correct**.

a) Ratio of their temperatures is 2 : 1
b) Ratio of their emissive powers is 4 : 1
c) Ratio of their rates of heat loss is 4 : 1
d) Ratio of their rates of cooling is 32 : 1

Q5 If the surface of a metal is successively exposed to radiation of λ_1 = 350 nm and λ_2 = 450 nm, the maximum speed of photoelectrons is halved. The work function of this metal is closest to (given h = 6.62×10^{-34} J- s)

a) 1.8 eV **b)** 2.5 eV **c)** 4.8 eV **d)** 3.9 eV

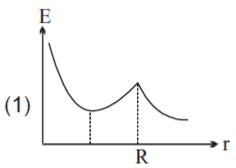
Q6 A plane wave of monochromatic light falls normally on a uniform thin film of oil which covers a glass plate. The wavelength of source can be varied continuously. Complete constructive interference of reflected lights from air–thin film interface and thin film – glass interface is observed for λ_1 = 5000 Å and λ_2 = 10000 Å and for no other wavelength in between. If refractive index of oil is 1.25 and that of glass is 1.5, the thickness of film (in μm) is

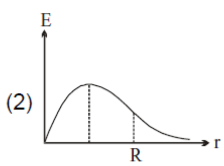
a) 0.2 **b)** 0.1 **c)** 0.8 **d)** 0.4

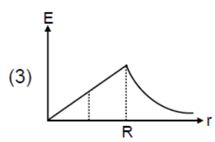
Q7 The shape of wave propagation in the positive x or negative x-direction is given by $y = \frac{1}{\sqrt{1+x^2}}$ at t=0 and $y = \frac{1}{\sqrt{2-2x+x^2}}$ at t =1s where x and y are in meters. The shape of the wave disturbance does not change during propagation. Find the velocity of the wave.

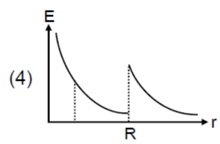
a) 1 m/s in positive x direction
b) 1 m/s in negative x direction
c) $\frac{1}{2}$ m/s in positive x direction
d) $\frac{1}{2}$ ms/s in negative x direction

Q8 A spherical insulator of radius R is charged uniformly with a charge Q uniformly distributed throughout its volume and contains a point charge $\frac{Q}{16}$ located at its centre. Which of the following graphs best represent qualitatively, the variation of electric field intensity E with distance r from the centre.

a)


b)


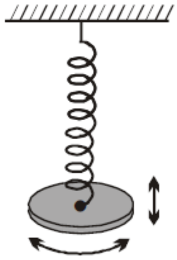
c)


d)


Q9 A particle of specific charge σ moving with a certain velocity v enters a uniform magnetic field of strength B directed along the negative Z-axis entending from x = r_1 to x = r_2. The minimum value of v required in order that the particle can just enter the region x > r_2 is :

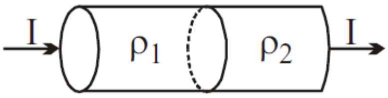
a) $\sigma r_2 B$ **b)** $\sigma\sqrt{r_1 r_2}B$ **c)** $\sigma(r_2 - r_1)B$ **d)** $\sigma\sqrt{r_2^2 - r_1^2}\,B$

Q10 A solid disk of radius R is suspended from a spring of linear spring constant k and torsional constant c, as shown in figure. In terms of k and c, what value of R will give the same period for the vertical and torsional oscillations of this system?



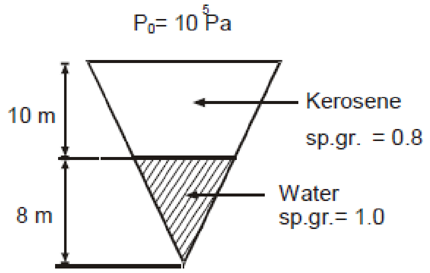
a) $\sqrt{\frac{2c}{k}}$ **b)** $\sqrt{\frac{c}{2k}}$ **c)** $2\sqrt{\frac{c}{k}}$ **d)** $\frac{1}{2}\sqrt{\frac{c}{k}}$

Q11 Two long straight cylindrical conductors with resistivities ρ_1 and ρ_2 respectively are joined together as shown in figure. The radius of each of the conductor is a. If a uniform total current I flows through the conductors, the magnitude of the total free charge at the interface of the two conductor is



a) Zero **b)** $\frac{(\rho_1 - \rho_2)I\varepsilon_0}{2}$ **c)** $\varepsilon_0 I|\rho_1 - \rho_2|$ **d)** $\varepsilon_0 I|\rho_1 + \rho_2|$

Q12 The figure shows a conical container of half-apex angle 37° filled with certain quantities of kerosene and water. The force exerted by the water on the kerosene is approximately – (Take atmospheric pressure = 10^5 Pa)

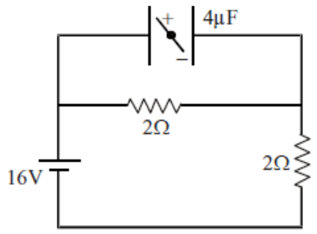


a) 3×10^7 N **b)** 4×10^7 N **c)** 2×10^7 N **d)** 5×10^7 N

Q13 An electron of mass m and magnitude of charge |e| initially at rest gets accelerated by a constant electric field E. The rate of change of de-Broglie wavelength of this electron at time t ignoring relativistic effects is

a) $-\frac{h}{|e|E\sqrt{t}}$ **b)** $\frac{-h}{|e|Et^2}$ **c)** $\frac{|e|Et^2}{h}$ **d)** $-\frac{h}{|e|Et}$

Q14 What is net force on the small dipole inside the capacitor if the plates are separated by 1 cm ?

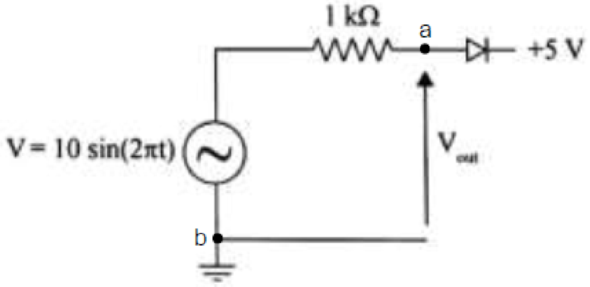


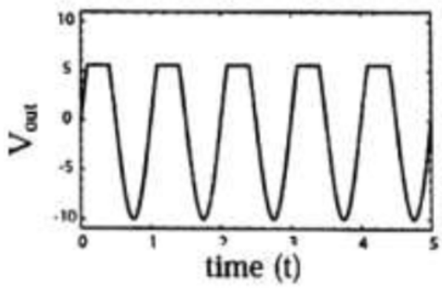
a) 0 N b) 4 N c) 8 N d) 16 N

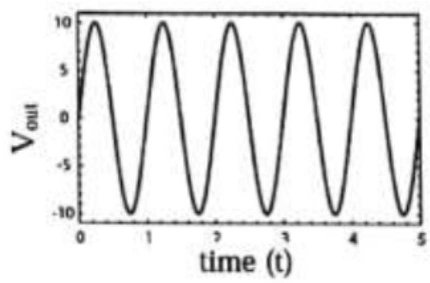
Q15 A uniform circular ring of radius R is fixed in plane. A particle is placed on the axis of the ring at a distance much greater than R and allowed to fall towards the ring under the influence of the ring's gravity. The particle achieves a maximum speed v. The ring is replaced with one of the same (linear) mass density but radius 2R, and the experiment is repeated. What is the new maximum speed of the particle?

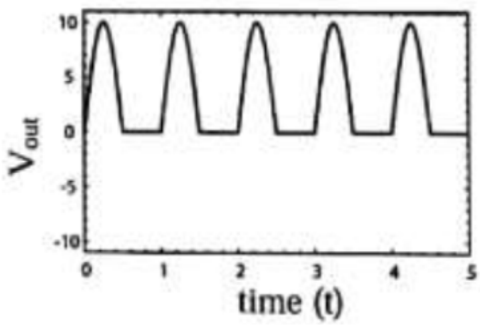
a) $\frac{1}{2}v$ b) $\frac{1}{\sqrt{2}}v$ c) v d) $\sqrt{2}v$

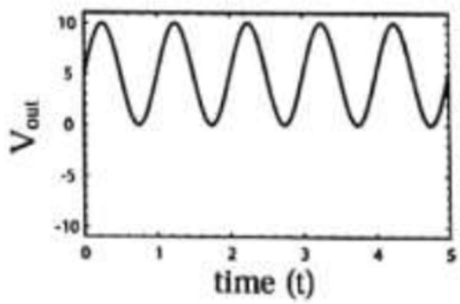
Q16 Consider the following ideal diode circuit. Which of the graph given below is a correct representation of V_{out} $(V_a - V_b)$? (Input and output voltage is in volt)



a)


b)


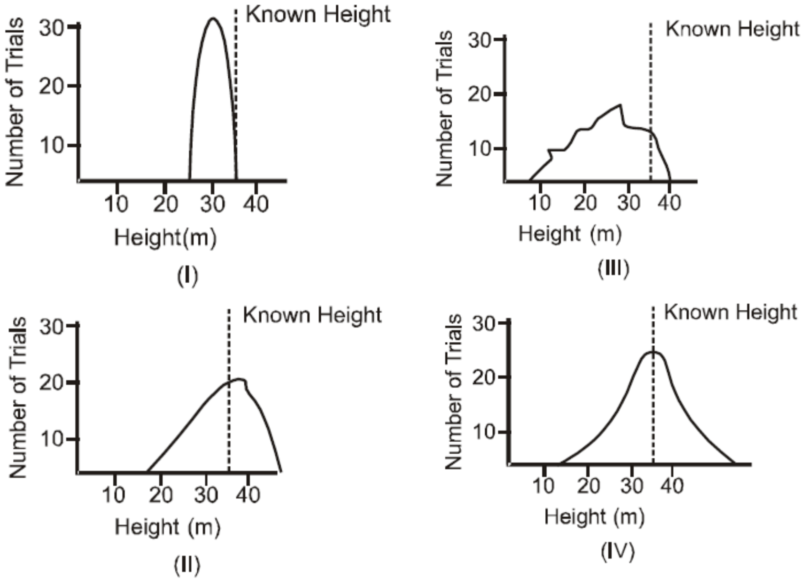
c)


d)


Q17 In an astronomical telescope in normal adjustment a straight black line of lenght L is drawn on just right side of objective lens. The eye-piece forms a real image of this line. The length of this image is I. The angular magnification of the telescope is :

a) $\frac{L}{I} - I$ **b)** $\frac{L+I}{L-I}$ **c)** $\frac{L}{I}$ **d)** $\frac{L}{I} + I$

Q18 Four students measure the height of a tower. Each student uses a different method and each measures the height many different times. The data for each are plotted below. The measurement with highest precision is :



a) IV **b)** II **c)** III **d)** I

Q19 The top of a water tank is open to air and its water level is maintained. It is giving out 0.74 m^3 water per minute through a circular opening of 2 cm radius in its wall. The depth of the centre of the opening from the level of water in the tank is close to:

a) 9.6 m **b)** 2.9 m **c)** 4.8 m **d)** 6.0 m

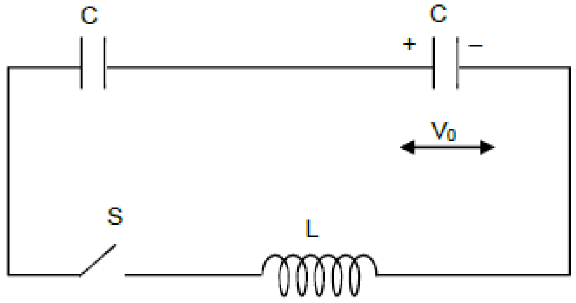
Q20 A steel rod is 4.000 cm in diameter at 30°C. A brass ring has an inner diameter of 3.992 cm at 30°C. In order that the ring just slides onto the steel rod, the common temperature of the two should be approximately (α_{steel}= 11 × 10^{-6}/°C and α_{brass}= 19 × 10^{-6}/°C)

a) 250°C **b)** 280°C **c)** 300°C **d)** 350°C

Numerical

Q21 A ball is thrown obliquely into the air. At a certain moment, the ball's velocity has an angle of 60° with the horizontal, with an upwards motion. Four seconds later, the angle is of 30° with horizontal, with a downward motion. Determine the sum of magnitude of height (in m) ascended and descended during this time interval. Given g = 10 m/s^2. Ignore air drag on the ball.

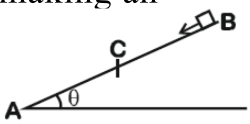
Q22 In the given electrical circuit both capacitors are identical. One of the capacitor is charged to voltage of V_0 volt. Now switch S is closed. Value of induced emf in inductor is $\frac{V_s}{\sqrt{a}}$ volt at the moment when energy in inductor is equal to half of total energy stored in capacitors. The value of a is.



Q23 In hydrogen atom, the binding energy of an electron in the ground state is E_1, then the frequency of revolution of the electron in the n^{th} orbit is $\frac{xE_1}{n^y h}$. Here x and y are integers. Find the value of x^y.

Q24 If the earth suddenly shrinks to $\frac{1}{64}$th of its original volume with its mass remaining the same, the period of rotation of earth becomes $\frac{24}{x}$ h. The value of x is____.

Q25 A small block starts slipping down from a point B on an inclined plane AB, which is making an

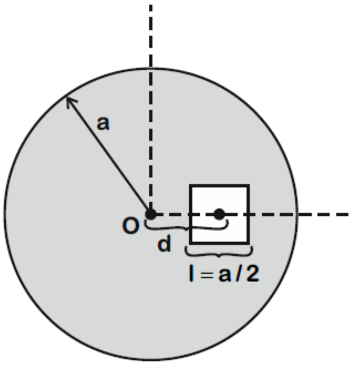


angle θ with the horizontal section BC is smooth and the remaining section CA is rough with a coefficient of friction μ . It is found that the block comes to rest as it reaches the bottom (point A) of the inclined plane. If BC = 2AC, the coefficient of friction is given by $\mu = k\tan\theta$. The value of k is __________.

Q26 When radiation of wavelength λ is used to illuminate a metallic surface, the stopping potential is V. When the same surface is illuminated with radiation of wavelength 3λ, the stopping potential is $\frac{V}{4}$. If the threshold wavelength for the metallic surface is nλ then value of n will be ___________.

Q27 A 5 μF capacitor is charged fully by a 220 V supply. It is then disconnected from the supply and is connected in series to another uncharged 2.5 μF capacitor. If the energy change during the charge redistribution is $\frac{X}{100}$J then value of X to the nearest integer is ______.

Q28 A square shaped hole of side $l = \frac{a}{2}$ is carved out at a distance $d = \frac{a}{2}$ from the centre 'O' of a uniform circular disk of radius a. If the distance of the centre of mass of the remaining portion from O is $-\frac{a}{X}$, value of X (to the nearest integer) is_______.



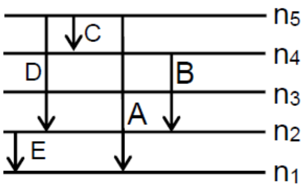
Q29 A wire of density 9 g cm^{-3} is stretched between two clamps 1 m apart. The resulting strain in the wire is 4.9×10^{-4}. The lowest frequency of the transverse vibrations in the wire is (Young's modulus of wire = 9×10^{10} Nm^{-2}), (to the nearest integer), __________.

Q30 A galvanometer coil has 500 turns and each turn has an average area of 3×10^{-4} m^2. If a torque of 1.5 Nm is required to keep this coil parallel to a magnetic field when a current of 0.5 A is flowing through it, the strength of the field (in T) is ______.

Chemistry

Single Choice Question

Q31 For H-atom some spectral lines were observed as shown. (n_1 to n_5 are successive shells). If 'E' belongs to visible region, then correct statements for the following transition.



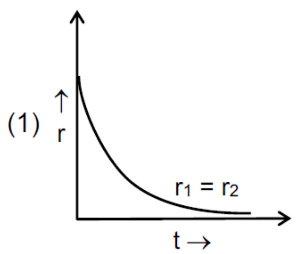
(A) There cannot be any line in UV region (B) B and D lines belongs to Infrared region.
(C) Line having shortest wavelength is A (D) Line having least energy is C

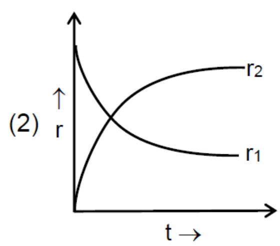
a) (A), (B) and (C)
b) (A) and (B)
c) (C) and (D)
d) (A), (B), (C) and (D)

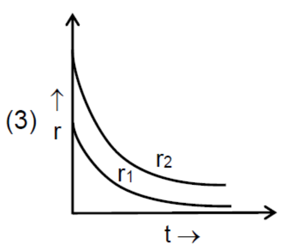
Q32 The reaction
$CH_4(g) + Cl_2(g) \longrightarrow CH_3Cl(g) + HCl(g)$ has
$\Delta H = -25$ kcal. The bond energies of C–Cl and H–Cl bonds are 84 and 103 kcal respectively. The ratio of bond energies of C–H and Cl–Cl bonds is x : y. If x : y = 9 : 5, from the given data, what is the bond energy of Cl–Cl bond?

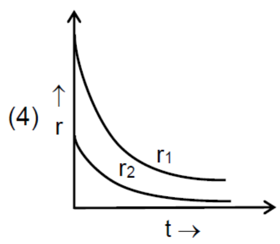
a) 70 kcal
b) 80 kcal
c) 67.85 kcal
d) 57.85 kcal

Q33 Consider the first order reaction :
$A \longrightarrow 2B$. Which of the following figure correctly describes the rate of disappearance of A(r_1) and rate of appearance of B(r_2) with time?

a)


b)


c)


d)


Q34 An ideal solution is prepared from A and B (both are volatile). The total vapour pressure of the solution is $\frac{2P_A^0.P_B^0}{P_A^0+P_B^0}$ Where $P_A^0$and P_B^0 are vapour pressures of pure A and B respectively. $[P_A^0 \neq P_B^0]$ If x_A, x_B represents mole fraction of A and B in solution respectively and y_A, y_B represents mole fraction of A and B in vapour phase. If $y_A = \frac{1}{2}$ then the value of x_A is :

a) $1 - y_A$ b) $1 - y_B$ c) $\frac{P_A^0}{P_A^0+P_A^0}$ d) $\frac{P_B^0}{P_A^0+P_B^0}$

Q35 $\Delta G = \Delta H - T\Delta S$ and $\Delta G = \Delta H + T[\frac{d(\Delta G)}{dT}]_p$

then $\left(\frac{dE_{cell}}{dT}\right)$ is :

a) $\frac{\Delta S}{nF}$ b) $\frac{nF}{\Delta S}$ c) $-nFE_{cell}$ d) $+nEF_{cell}$

Q36 Pyrolusite is MnO_2 used to prepare $KMnO_4$. Steps are,

$MnO_2 \xrightarrow{I} MnO_4^{2-} \xrightarrow{II} MnO_4^-$

Steps I and II are respectively :

(A) fuse with KOH, air and electrolytic oxidation.

(B) fuse with KOH, KNO_3 and oxidation by O_3.

(C) fuse with conc. HNO_3, air and electrolytic reduction.

(D) dissolve in H_2O and oxidation.

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

Q37 In the flame test of a mixture of salts, a green flame with blue centre was observed. Which one of the following cations may be present?

a) Cu^{2+} b) Sr^{2+} c) Ba^{2+} d) Ca^{2+}

Q38 Given below are two statements :one is labelled as Assertion A and the other is labelled as Reason R

Assertion A : In $T\ell I_3$, isomorphous to CsI_3, the metal is present in +1 oxidation state.

Reason R : $T\ell$ metal has fourteen f electrons in the electronic configuration.

In the light of the above statements, choose the most appropriate answer from the options given below:

a) **A** is correct but **R** is not correct

b) Both **A** and **R** are correct and **R** is the correct explanation of **A**.

c) **A** is not correct but **R** is correct

d) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**.

Q39 Which of the following statements are correct
(A) Order of oxidizing strength $F_2 > Cl_2 > Br_2 > I_2$
(B) Order of melting point HF > HI > HBr > HCl
(C) Order of bond dissociation enthalpy $Cl_2 > Br_2 > F_2 > I_2$
(D) Order of first ionization energy B > Tl > Ga > Al > In

a) (A), (C) & (D) **b)** (A), (B), (C) & (D)
c) (B), (C) & (D) **d)** (A), (B) & (C)

Q40 To prepare a buffer solution of pH = 4.74, amount of Barium acetate to be added to 100 mL of 0.1 M acetic acid solution $[pK_b(CH_3COO^-) = 9.96]$ is :

a) 0.05 mole **b)** 0.025 mole **c)** 0.1 mole **d)** 0.005 mole

Q41 The results given in the below table were obtained during kinetic studies of the following reaction
$2A + B \rightarrow C + D$

Experiment	[A]/ $molL^{-1}$	[B]/ $molL^{-1}$	Initial rate / $molL^{-1} min^{-1}$
I	0.1	0.1	6.00×10^{-3}
II	0.1	0.2	2.40×10^{-2}
III	0.2	0.1	1.20×10^{-2}
IV	X	0.2	7.20×10^{-2}
V	0.3	Y	2.88×10^{-1}

X and Y in the given table are respectively

a) 0.4, 0.3 **b)** 0.3, 0.4 **c)** 0.4, 0.4 **d)** 0.3, 0.3

Q42 Consider the following reaction approaching equilibrium at 27°C and 1 atm pressure

$$A + B \underset{K_b = 10^2}{\overset{K_f = 10^3}{\rightleftharpoons}} C + D$$

The standard Gibb's energy change $(\Delta_r G°)$ at 27°C is $(kJ\ mol^{-1})$.
(Given : $R = 8.3\ J\ K^{-1}\ mol^{-1}$ and ln 10 = 2.3)

a) $-5.7\ KJ\ mol^{-1}$ **b)** $+5.7\ KJ\ mol^{-1}$ **c)** $-6.7\ KJ\ mol^{-1}$ **d)** $-7.7\ KJ\ mol^{-1}$

Q43 The value of crystal field splitting (Δ_o) for $[Ti(H_2O)_6]^{3+}$ is 243 $KJ\ mol^{-1}$. The crystal field stabilization energy (CFSE) in this complex is : (in $KJ\ mol^{-1}$)

a) –145.8 **b)** –97.2 **c)** –291.6 **d)** –243

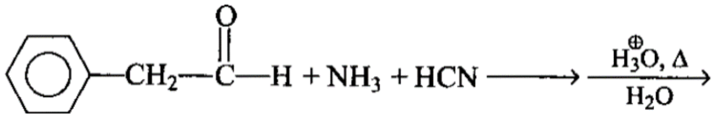
Q44
$$PhCH_3 + (CH_3CO)_2O \xrightarrow[273K]{CrO_3} P \xrightarrow[\Delta]{H_3O^+}$$

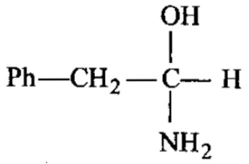
$$Q \xrightarrow[CH_3COONa]{(CH_3CO)_2O, \Delta} R$$ Product R is

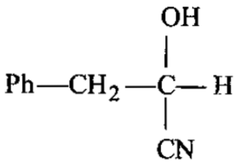
a) Cinnamic acid **b)** Mandelic acid
c) Phthalic acid **d)** Phenyl acetic acid

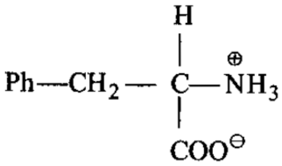
Q45 Order of pKa values for following acids is –
(a) $CH_3–COOH$ (b) $O_2N – CH_2 – COOH$ (c) $NC – CH_2 – COOH$ (d) $MeO – CH_2 – COOH$

a) b > a > c > d **b)** a > d > c > b **c)** a > d > b > c **d)** b > c > d > a

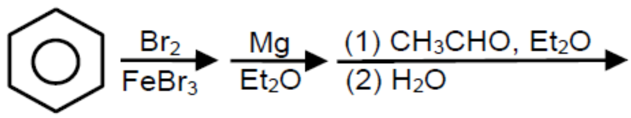
Q46 
Product:

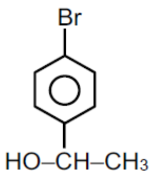
a) 

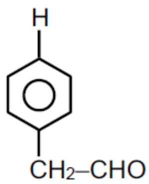
b) 

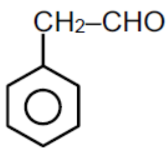
c) 

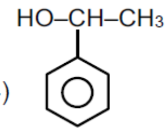
d) All of these

Q47 Final product of the given reaction is :


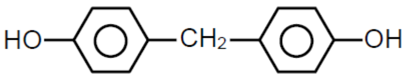
a) (1) 

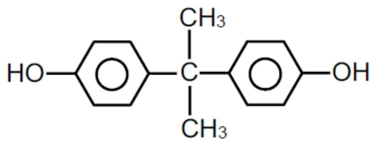
b) (2) 

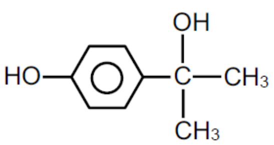
c) (3) 

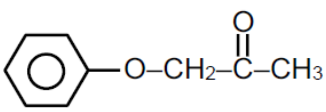
d) (4) 

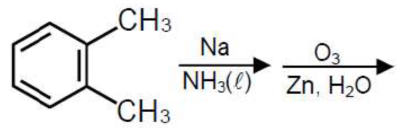
Q48 DDT is prepared by reaction between chlorobenzene and chloral in presence of H_2SO_4 then what product will be form by reaction between phenol and acetone in presence of H_2SO_4 ?

a) (1) 

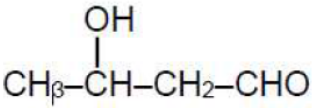
b) (2) 

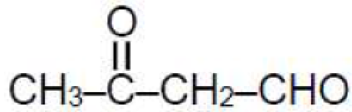
c) (3) 

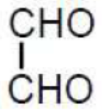
d) (4) 

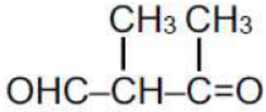
Q49 

In the above reaction final major product is :

a) 

b) 

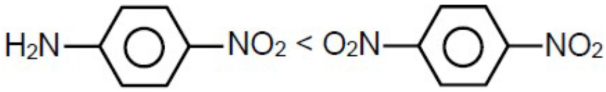
c) 

d) 

Q50 Which is correct order regarding the dipole moments of the following molecules ?

a) CH_3–CH_3–Cl < CH_2=CH–Cl

b) CH_3–CH_3–CH=O < CH_2=CH–CH=O

c) 

d) CH_3–Cl < CH_3–F

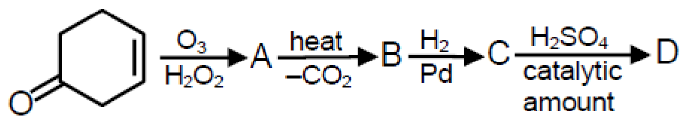
Numerical

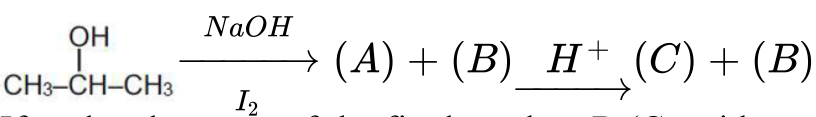
Q51 15 mL of aqueous solution of Fe^{2+} in acidic medium completely reacted with 20 mL of 0.03 M aqueous $Cr_2O_7^{2-}$. The molarity of the Fe^{2+} solution is ________ $\times 10^{-2}$ M (Round off to the Nearest Integer).

Q52 For given simultaneous reaction :
X(s) $\leftrightharpoons$ A(g) + B(s) + C(g) $K_{P_1} = 500$ atm^2
Y(s) $\leftrightharpoons$ D(g) + A(g) + E(s) $K_{P_2} = 2000$ atm^2
Find equilibrium partial pressure of gas D (in atm).

Q53 The number of sigma bonds in $Mn_2(CO)_{10}$ is:

Q54 If molecular mass of the final product D is (W) then report your answer as (W/10) in the following reaction–



Q55 

If molecular mass of the final product B (Consider product having higher molecular mass) is W than report your answer as W/10 in given reaction? Consider molecular mass of carbon = 12, hydrogen = 1, oxygen = 16, iodine = 127 (Nearest Integer)

Q56 Total number of species which used all three p-orbitals in hybridization of central atoms and should be non-polar also.

$XeO_2F_2, SnCl_2, IF_5, I_3^+, XeO_4, SO_2, XeF_7^+, SeF_4$

Q57 A student has studied the decomposition of a gas AB_3 at 25°C. He obtained the following data.

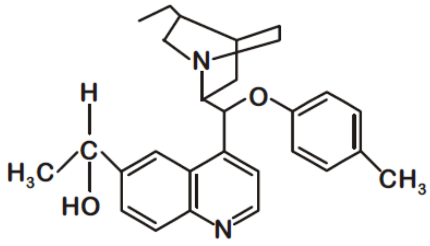
p (mm Hg)	50	100	200	400
Relative $t_{1/2}$ (s)	4	2	1	0.5

The order of the reaction is ______

Q58 The oxidation states of iron atoms in compounds (A), (B) and (C), respectively, are x, y and z. The sum of x, y and z is ________.

$Na_4[Fe(CN)_5(NOS)]$ (A) $Na_4[FeO_4]$ (B) $[Fe_2(CO)_9]$ (C)

Q59 The number of chiral carbons present in the molecule given below is ______.



Q60 A commercially sold conc. HCl is 35% HCl by mass. If the density of this commercial acid is 1.46 g/mL, the molarity of this solution is :
(Atomic mass : Cl = 35.5 amu, H = 1 amu)

Mathematics

Single Choice Question

Q61 P is a variable point on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=2$ whose foci are F_1 and F_2 then maximum area of ΔPF_1F_2 is: Given (a > b)

a) $2a\sqrt{a^2-b^2}$ **b)** $2b\sqrt{a^2-b^2}$ **c)** $a\sqrt{(2a^2-2b^2)}$ **d)** $b\sqrt{(2a^2-2b^2)}$

Q62 Let the mean of the data

x	1	3	5	7	9
Frequency (f)	4	24	28	α	8

be 5. If m and σ^2 are respectively the mean deviation about the mean and the variance of the data, then $\frac{3\alpha}{m+\sigma^2}$ is equal to ________.

a) 2 **b)** 4 **c)** 6 **d)** 8

Q63 If a ∈(–20, 0) then the probability that the graph of the function $y = 16x^2 + 8ax + 40x - 7a - 5$, is strictly above the x-axis, is

a) $\frac{14}{20}$ **b)** $\frac{14}{21}$ **c)** $\frac{13}{21}$ **d)** $\frac{13}{20}$

Q64 If 1, $z_1, z_2, \ldots z_{n-1}$ are the n^{th} roots of unity then the value of $\frac{1}{3-z_1}+\frac{1}{3-z_2}+\ldots..+\frac{1}{3-z_{n-1}}$ is equal to

a) $\frac{n.3^{n-1}}{3^n-1}+\frac{1}{2}$ **b)** $\frac{n.3^{n-1}}{3^n-1}-1$ **c)** $\frac{n.3^{n-1}}{3^n-1}+1$ **d)** $\frac{n.3^{n-1}}{3^n-1}-\frac{1}{2}$

Q65 Let $f(x) = \int_2^x \frac{dt}{\sqrt{1+t^4}}$ and g be the inverse of f(x) then the value of g'(0) is

a) 1 **b)** 17 **c)** $\sqrt{17}$ **d)** 0

Q66 The function $f(x) = [x]cos(\pi(\frac{2x-1}{2}))$, (where [.] denotes the greatest integer functions) is discontinuous

a) for each real x **b)** for each integral point
c) no where **d)** at each non-integral point

Q67 Let $f(x)=\lim_{n\to\infty}\frac{1}{\left(\frac{3}{\pi}\tan^{-1}2x\right)^{2n}+5}$ then the set of values of x for which f(x) = 0 is

a) $|2x|>\sqrt{3}$ **b)** $|2x|<\sqrt{3}$ **c)** $|2x|\geq 6$ **d)** $|2x|\leq\sqrt{3}$

Q68 The range of the function f(x) = $(1 + \sec^{-1}x)(1 + \cos^{-1})$ is

a) $(-\infty, \infty)$
b) $(-\infty, 0] \cup [4, \infty)$
c) $\{1, (1+\pi)^2\}$
d) $\{0, (1+\pi)^2\}$

Q69 The shortest distance between the lines $\frac{x+7}{-6} = \frac{y-6}{7} = z$ and $\frac{7-x}{2} = y - 2 = z - 6$ is

a) $2\sqrt{29}$
b) 1
c) $\sqrt{\frac{37}{29}}$
d) $\frac{\sqrt{29}}{2}$

Q70 Let $f(x) = \int \frac{dx}{(3+4x^2)\sqrt{4-3x^2}}, |x| < \frac{2}{\sqrt{3}}$. If f(0) = 0 and $f(1) = \frac{1}{\alpha\beta}\tan^{-1}\left(\frac{\alpha}{\beta}\right)$, $\alpha, \beta > 0$, then $\alpha^2 + \beta^2$ is equal to ____.

a) 29
b) 1
c) 37
d) 28

Q71 A value of α such that $\int_{\alpha}^{\alpha+1} \frac{dx}{(x+\alpha)(x+\alpha+1)} = \log_e\left(\frac{9}{8}\right)$ is:

a) $\frac{1}{2}$
b) -2
c) $-\frac{1}{2}$
d) 2

Q72 $2f\left(\frac{x}{2}\right) + 3f\left(\frac{2-x}{3}\right) = g(x)$, $0 < x < 3, f''(x) > 0$ then g(x) is strictly increasing in

a) (0, 3)
b) $\left(0, \frac{4}{5}\right)$
c) $\left(\frac{4}{5}, 3\right)$
d) (0, 2)

Q73 Considering only the principal values of the inverse trigonometric functions, the domain of the function f(x) = $\cos^{-1}\left(\frac{x^2-4x+2}{x^2+3}\right)$ is :

a) $\left(-\infty, \frac{1}{4}\right]$
b) $\left[-\frac{1}{4}, \infty\right)$
c) $\left(-\frac{1}{3}, \infty\right)$
d) $\left(-\infty, \frac{1}{3}\right]$

Q74 The point P (1, 1) is translated parallel to 2x = y in the first quadrant through a unit distance. The coordinates of the point P in new position are

a) $\left(1 \pm \frac{1}{\sqrt{5}}, 1 \pm \frac{1}{\sqrt{5}}\right)$
b) $\left(1 \pm \frac{1}{\sqrt{5}}, 1 \pm \frac{2}{\sqrt{5}}\right)$
c) $\left(\frac{1}{\sqrt{5}}, \frac{2}{\sqrt{5}}\right)$
d) $\left(\frac{2}{\sqrt{5}}, \frac{1}{\sqrt{5}}\right)$

Q75 Area bounded by the region $R \equiv \{(x,y) : y^2 \le x \le |y|\}$ is

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

Q76 The number of natural numbers lying between 1012 and 23421 that can be formed using the digits 2, 3, 4, 5, 6 (repetition of digits is not allowed) and divisible by 55 is ____.

a) 4
b) 3
c) 2
d) 6

Q77 A parabola is drawn whose focus is one of the foci of the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ and whose directrix passes through the other focus and perpendicular to the transverse axis. If the latus rectum of the hyperbola and parabola are same, then the eccentricity of the hyperbola is

a) $2\sqrt{2}+1$ b) $1+\sqrt{2}$ c) $2\sqrt{2}-1$ d) $2\sqrt{2}$

Q78 Let $S=\left\{\alpha:\log_2(9^{2\alpha-4}+13)-\log_2\left(\frac{5}{2}\cdot 3^{2\alpha-4}+1\right)=2\right\}$. Then the maximum value of β for which the equation $x^2-2\left(\sum_{\alpha\in S}\alpha\right)^2 x+\sum_{\alpha\in S}(\alpha+1)^2\beta=0$ has real roots, is _____ .

a) 22 b) 12 c) 32 d) 25

Q79 A ratio of the 5^{th} term from the beginning to the 5^{th} term from the end in the binomial expansion of $\left(2^{\frac{1}{3}}+\frac{1}{2(3)^{\frac{1}{3}}}\right)^{10}$ is

a) $1:4(16)^{\frac{1}{3}}$ b) $1:2(6)^{\frac{1}{3}}$ c) $2(36)^{\frac{1}{3}}:1$ d) $4(36)^{\frac{1}{3}}:1$

Q80 Let R be a relation from the set {1, 2, 3 ...., 60} to itself such that R = {(a, b) : b = pq, where p, q ≥ 3 are prime numbers}. Then, the number of elements in R is :

a) 600 b) 660 c) 540 d) 720

Numerical

Q81 Let $\vec{a},\vec{b}$ and $\vec{c}$ be three unit vectors such that $|\vec{a}-\vec{b}|^2+|\vec{a}-\vec{c}|^2=8$ Then $|\vec{a}+2\vec{b}|^2+|\vec{a}+2\vec{c}|^2$ is equal to

Q82 If the terms of the AP. $\sqrt{a-x},\sqrt{x},\sqrt{a+x}$ are all integers where a > x> 0 then the least composite odd integral value of a is

Q83 A function f from integers to integers is diffined as f(x) = $\begin{cases} n+3, n \text{ is odd} \\ \frac{n}{2}, n \text{ is even} \end{cases}$ .If k is an odd integer and f(f(f(k))) = 27 then the sum of digits of k is

Q84 If $f(x)=x^n$, n ∈N, then the value of $f(1)-\frac{f'(1)}{1!}+\frac{f''(1)}{2!}-\frac{f'''(1)}{3!}+.....+(-1)^n\frac{f^n(1)}{n!}$ is

Q85 If $A=\begin{bmatrix}1&-1&1\\0&2&-3\\2&1&0\end{bmatrix}$, B = (adj A) and C = 5A, then $\frac{|\text{adj } B|}{|C|}=$

Q86 The number of values of k, for which the system of equation :
$kx + (3k + 2)y = 4k$
$(3k - 1)x + (9k + 1)y = 4(k + 1)$
has no solution, is/are

Q87 If a, b, c are distinct odd integers and ω is non real cube root of unity and minimum value of $|a\omega^2 + b + c\omega|$ is k, then value of k^2 is

Q88 If y = y(x) is the solution of the differential equation $\frac{dy}{dx} + \frac{4x}{(x^2-1)}y = \frac{x+2}{(x^2-1)^{5/2}}$, x > 1 such that $y(2) = \frac{2}{9}\log_e(2+\sqrt{3})$ and $y(\sqrt{2}) = \alpha\log_e(\sqrt{\alpha}+\beta)+\beta-\sqrt{\gamma}$, $\alpha, \beta, \gamma \in N$, then αβγ is equal to_____.

Q89 The number of integral values of k for which the line, 3x + 4y = k intersects the circle, $x^2 + y^2 - 2x - 4y + 4 = 0$ at two distinct points is______.

Q90 If $z \neq 0$, then $\int_{x=0}^{100} [\arg|z|]dx$ is
(where [.] denotes the greatest integer function)
z is complex number

Answer Key

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**D**	**B**	**D**	**B**	**B**	**D**	**A**	**A**	**C**	**A**
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	**C**	**C**	**B**	**A**	**C**	**A**	**C**	**D**	**C**	**B**
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	**50**	**3**	**8**	**16**	**3**	**9**	**4**	**23**	**35**	**20**
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	**D**	**D**	**B**	**D**	**A**	**A**	**A**	**D**	**A**	**B**
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	**B**	**A**	**B**	**A**	**B**	**C**	**D**	**B**	**B**	**B**
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	**24**	**40**	**21**	**10**	**39**	**2**	**2**	**6**	**5**	**14**
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	**B**	**D**	**D**	**D**	**C**	**C**	**A**	**C**	**A**	**D**
Que.	71	72	73	74	75	76	77	78	79	80
Ans.	**B**	**C**	**B**	**B**	**C**	**D**	**B**	**D**	**D**	**B**
Que.	81	82	83	84	85	86	87	88	89	90
Ans.	**2**	**45**	**6**	**0**	**1**	**0**	**12**	**6**	**9**	**0**