Competishun

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

Date: 19/01/2024

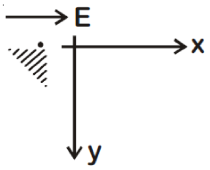
Time: 3 hours **Max. Marks:** 300

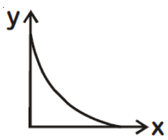
MFST-14_(23-24)_UTS-2_MT-8

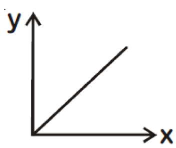
Physics

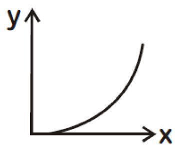
Single Choice Question

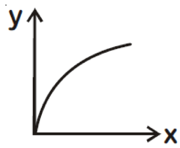
Q1 A small point mass carrying some positive charge on it, is released from the edge of a table. There is a uniform electric field in this region in the horizontal direction. Which of the following options then correctly describe the trajectory of the mass? (Curves are drawn schematically and are not to scale).



a) 

b) 

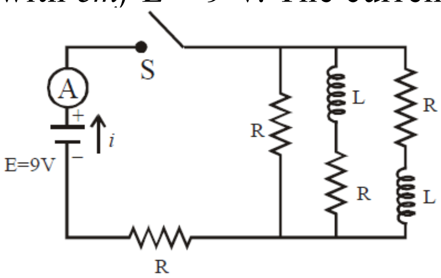
c) 

d) 

Q2 A particle executes S.H.M. of amplitude A along x-axis. At t = 0, the position of the particle is $x = \frac{A}{2}$ and it moves along positive x-axis the displacement of particle in time t as the function of $x = A \sin(\omega t + \delta)$, then the value δ will be :

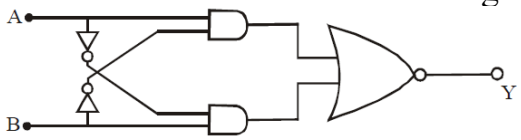
a) $\frac{\pi}{6}$ **b)** $\frac{\pi}{3}$ **c)** $\frac{\pi}{4}$ **d)** $\frac{\pi}{2}$

Q3 Figure shows a circuit that contains four identical resistors with resistance $R = 2.0\ \Omega$, two identical inductors with inductance L = 2.0 mH and an ideal battery with *emf* E = 9 V. The current 'i' just after the switch 'S' is closed will be:



a) 2.25 A **b)** 3.0 A **c)** 3.37 A **d)** 9 A

Q4 The truth table for the following logic circuit is :



a)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

b)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

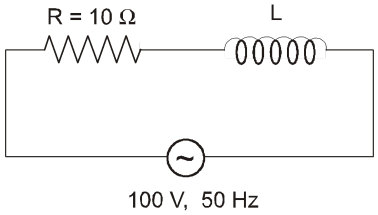
c)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

d)

A	B	Y
0	0	0
0	1	1
1	0	0
1	1	1

Q5 In LR circuit (shown in figure), current is lagging by $\frac{\pi}{3}$ in phase with applied voltage, then select correct alternative :



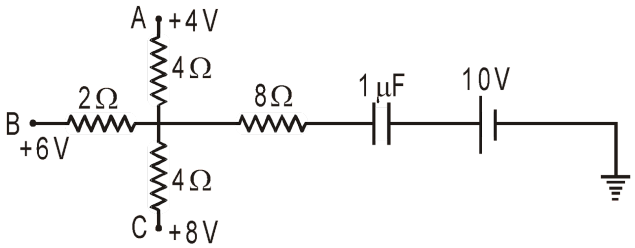
a) $L = \frac{10}{\sqrt{3}\pi}$ H, i = 10 A

b) $L = \frac{10}{\pi}$ H, i = 5A

c) $L = \frac{\sqrt{3}}{10\pi}$ H, i = 5A

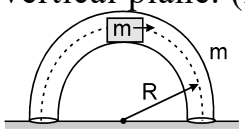
d) $L = \frac{10}{\sqrt{3}\pi}$, $i = 5\sqrt{2}$ A

Q6 Figure shows a part of network of a capacitor and resistors. The potential indicated at A, B and C are with respect to the ground. The charge on the capacitor in steady state is



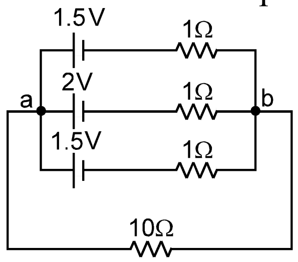
a) 4 μC **b)** 6 μC **c)** 10 μC **d)** 16 μC

Q7 In a vertical plane inside a smooth hollow thin tube a block of same mass as that of tube is released as shown in figure. When it is slightly disturbed it moves towards right. By the time the block reaches the right end of the tube then the displacement of the tube will be (where 'R' is mean radius of tube). Assume that the tube remains in vertical plane. (Horizontal plane is smooth)



a) $\frac{2R}{\pi}$ **b)** $\frac{4R}{\pi}$ **c)** $\frac{R}{2}$ **d)** R

Q8 Find the current passing through 10\(\Omega\) resistance in the figure below

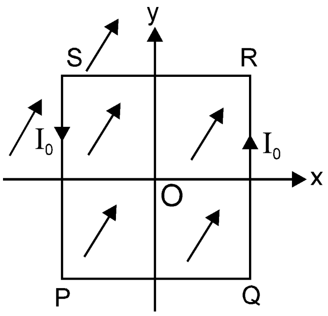


a) 5/31 A **b)** 6/31 A **c)** 4/31 A **d)** none of these

Q9 Consider a uniformly charged spherical shell of radius 'a'. Net charge on shell is Q. The shell is surrounded by another uncharged concentric shell of radius 'b'. The work done by external agent in charging outer shell with uniform charge –Q is.

a) $-\frac{KQ^2}{b}$ **b)** $\frac{KQ^2}{a}-\frac{KQ^2}{b}$ **c)** $\frac{KQ^2}{2a}-\frac{KQ^2}{2b}$ **d)** $-\frac{KQ^2}{2b}$

Q10 A uniform, constant magnetic field \(\overrightarrow B\) is directed at an angle of 45° to the x-axis in the xy-plane, PQRS is a rigid square wire frame carrying a steady current I_0, with its centre at the origin O. At time t = 0, the frame is at rest in the position shown in the figure, with its sides parallel to the x and y axes. Each side of the frame is of mass M and length L.

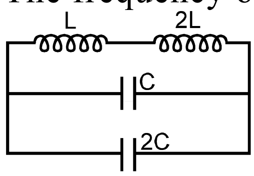


The torque \(\overrightarrow \tau\) about O acting on the frame due to the magnetic field will be

a) \(\overrightarrow \tau\) = $\frac{BI_0L^2}{\sqrt{2}}(-\hat{i}+\hat{j})$ **b)** \(\overrightarrow \tau\)= $\frac{BI_0L^2}{\sqrt{2}}(\hat{i}-\hat{j})$

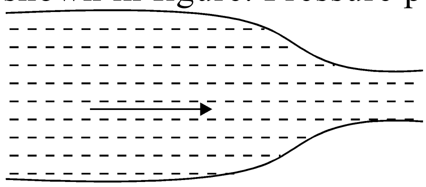
c) \(\overrightarrow \tau\)= $\frac{BI_0L^2}{\sqrt{2}}(\hat{i}+\hat{j})$ **d)** \(\overrightarrow \tau\) = $\frac{BI_0L^2}{\sqrt{2}}(-\hat{i}-\hat{j})$

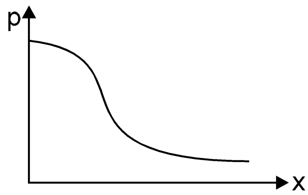
Q11 The frequency of oscillation of current in the inductor is :

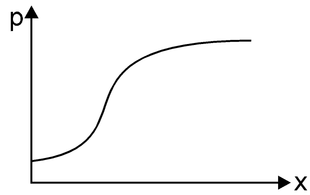


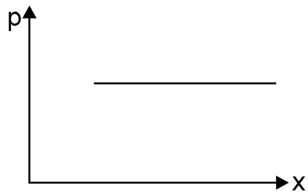
a) $\frac{1}{3\sqrt{LC}}$ **b)** $\frac{1}{6\pi\sqrt{LC}}$ **c)** $\frac{1}{\sqrt{LC}}$ **d)** $\frac{1}{2\pi\sqrt{LC}}$

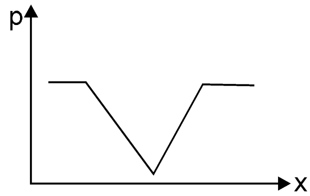
Q12 Water flows through a frictionless horizontal duct with a cross-section varying as shown in figure. Pressure p at points along the axis is represented by:



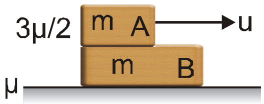
a) 

b) 

c) 

d) 

Q13 In the figure shown a block A of mass m is kept on block B of mass m. A is given a velocity towards right as shown. The coefficient of friction between A and B is $\frac{3\mu}{2}$ and that between B and ground is μ.



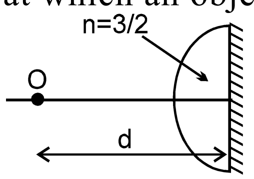
a) B will accelerate towards right with acceleration $\frac{\mu g}{2}$.

b) B will accelerate towards left with acceleration $\frac{\mu g}{2}$.

c) B will not accelerate at all.

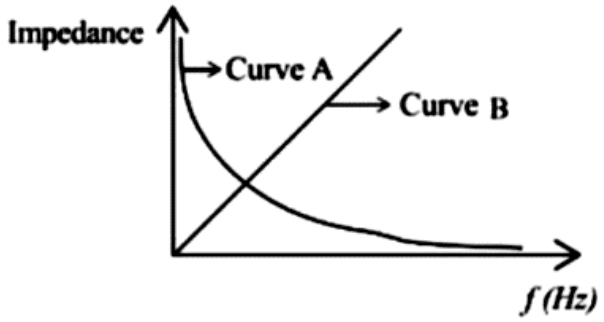
d) B will move towards right with acceleration μg.

Q14 A plano-convex lens of focal length 10 cm is silvered at its plane face. The distance d at which an object must be placed in order to get its image on itself is:



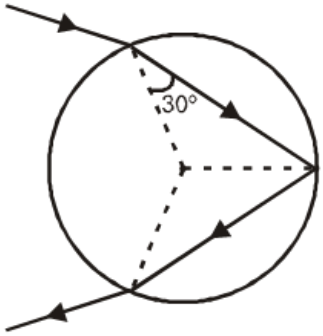
a) 5 cm **b)** 20 cm **c)** 10 cm **d)** 2.5 cm

Q15 As per the given graph choose the correct representation for curve A and curve B.
{Where X_C = reactance of pure capacitive circuit connected with A.C. source
X_L = reactance of pure inductive circuit connected with A.C. source
R = impedance of pure resistive circuit connected with A.C. source
Z = Impedance of the LCR series circuit}



a) $A = X_C, B = R$ **b)** $A = X_L, B = Z$ **c)** $A = X_C, B = X_L$ **d)** $A = X_L, B = R$

Q16 A ray is incident from air on a sphere of refractive index $\sqrt{2}$ as shown in figure. Angle of refraction of the ray inside sphere is 30º. The total deviation suffered by the ray is



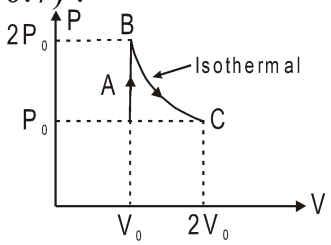
a) 150° **b)** 120° **c)** 90° **d)** 45°

Q17 Two particles of combined mass M, placed in space with certain separation, are released. Interaction between the particles is only of gravitational nature and there is no external force present. Acceleration of one particle with respect to the other when separation between them is R, has a magnitude :

a) $\frac{GM}{2R^2}$ **b)** $\frac{GM}{R^2}$ **c)** $\frac{2GM}{R^2}$

d) not possible to calculate due to lack of information

Q18 A diatomic ideal gas undergoes a thermodynamic change according to the P–V diagram shown in the figure. The total heat given to the gas is nearly (use \(\ell\)n2 = 0.7) :



a) $2.5\ P_0V_0$ **b)** $1.4\ P_0V_0$ **c)** $3.9\ P_0V_0$ **d)** $1.1\ P_0V_0$

Q19 A diatomic ideal gas is heated at constant volume until the pressure is doubled and again heated at constant pressure until volume is doubled. The average molar heat capacity for whole process is:

a) $\frac{13\,R}{6}$ b) $\frac{19\,R}{6}$ c) $\frac{23\,R}{6}$ d) $\frac{17\,R}{6}$

Q20 A proton with a kinetic energy of 2.0 eV moves into a region of uniform magnetic field of magnitude $\frac{\pi}{2} \times 10^{-3}\,T$. The angle between the direction of magnetic field and velocity of proton is 60°. The pitch of the helical path taken by the proton is________cm.
(Take, mass of proton = 1.6×10^{-27} kg and Charge on proton = 1.6×10^{-19} C).

a) 30 b) 35 c) 40 d) 42

Numerical

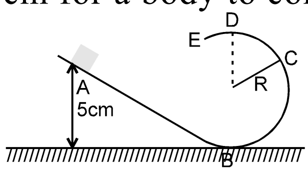
Q21 A circular coil of radius 10 cm is placed in a uniform magnetic field of 3.0×10^{-5} T with its plane perpendicular to the field initially. It is rotated at constant angular speed about an axis along the diameter of coil and perpendicular to magnetic field so that it undergoes half of rotation in 0.2 s. The maximum value of EMF induced (in μV) in the coil will be close to the integer ________.
(Take $\pi^2 \approx 10$)

Q22 The work functions of Aluminium and Gold are 4.1 eV and 5.1 eV respectively. The ratio of the slope of the stopping potential versus frequency plot for Gold to that of Aluminium is

Q23 A uniform metallic wire is elongated by 0.04 m when subjected to a linear force F. The elongation, if its length and diameter is doubled and subjected to the same force will be ______cm.

Q24 A proton and an α-particle are accelerated from rest by 2V and 4V potentials, respectively. The ratio of their de-Broglie wavelength is K:1, find value of K.

Q25 A frictionless track ABCDE ends in a circular loop of radius R. A body slides down the track from point A which is at height h = 5 cm. Find the maximum value of R in cm for a body to complete the loop successfully.



Q26 The difference between (n + 2)th Bohr radius and nth Bohr radius is equal to the (n – 2)th Bohr radius. The value of n is ?

Q27 Two sound sources produce progressive waves given by y_1 =12 cos 100\(\pi\)t and y_2 = 4 cos 102\(\pi\)t near the ear of an observer. When sounded together, then find beats frequency heared by observer is :

Q28 Given $|\vec{A}_1| = 2$, $|\vec{A}_2| = 3$ and $|\vec{A}_1 + \vec{A}_2| = 3$. Find the value of $\frac{(\vec{A}_1 + 2\vec{A}_2).(4\vec{A}_2 - 3\vec{A}_1)}{16}$.

Q29 A boat which can move with a speed of 5 m/s relative to water crosses a river of width 480 m flowing with a constant speed of 4 m/s. Find the time (in sec.) taken by the boat to cross the river along the path which is shortest.

Q30 A train stopping at two stations 2 km apart on a straight line takes 4 minutes for the journey. Assuming that its motion is first uniformly accelerated and then uniformly retarded. Find value of $\frac{1}{x} + \frac{1}{y}$
[where ' x ' and ' y ' are the magnitude of the acceleration and retardation respectively in (km/min^2)].

Chemistry

Single Choice Question

Q31 A sulphate of a metal (A) on heating evolves two gases (B) and (C) and an oxide (D). Gas (B) turns $K_2Cr_2O_7$ paper green while gas (C) forms a trimer in which there is no S—S bond. Compound (D) with conc. HCl forms a Lewis acid (E) which exists in a dimer. Compounds (A), (B), (C), (D) and (E) are respectively:

a) $FeSO_4$, SO_2, SO_3, Fe_2O_3, $FeCl_3$ **b)** $Al_2(SO_4)_3$,SO_2, SO_3 Al_2O_3, $AlCl_3$

c) FeS, SO_2, SO_3, $FeSO_4$, $FeCl_3$ **d)** FeS, SO_2, SO_3, $Fe_2(PO_4)_3$, $FeCl_2$

Q32 The correct order for the wavelength of absorption in the visible region is :

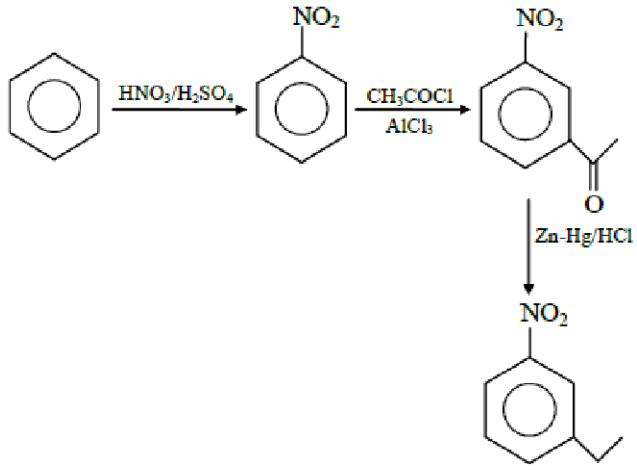
a) $[Ni(NO_2)_6]^{4-} < [Ni(NH_3)_6]^{2+} < [Ni(H_2O)_6]^{2+}$

b) $Ni(NO_2)_6]^{4-} < [Ni(H_2O)_6]^{2+} < [Ni(NH_3)_6]^{2+}$

c) $[Ni(H_2O)_6]^{2+} < [Ni(NH_3)_6]^{2+} < [Ni(NO_2)_6]^{4-}$

d) $[Ni(NH_3)_6]^{2+} < [Ni(H_2O)_6]^{2+} < [Ni(NO_2)_6]^{4-}$

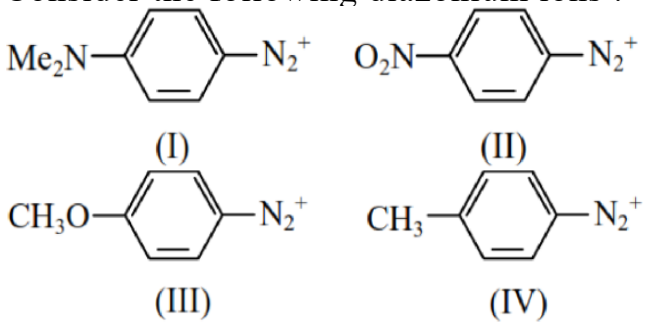
Q33



Which step is wrong in above synthesis ?

a) (i) **b)** (ii) **c)** (iii) **d)** None

Q34 Consider the following diazonium ions :



The order of reactivity towards diazo-coupling with phenol in the presence of dil. NaOH is –

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

Q35 Which of the following substances can not used directly as fertilizer?

a) $(NH_4)_2 SO_4$ **b)** $Ca_3(PO_4)_2$ **c)** $Ca(H_2PO_4)_2$ **d)** $CaCN_2 + C$

Q36 On heating $NaNO_3$ gives :

a) O_2 **b)** NO_2 **c)** $O_2 + NO_2$ **d)** NaNO

Q37 If equivalent conductance of 1M benzoic acid is 12.8 $ohm^{-1}\ cm^2\ eq^{-1}$ and if the conductance of benzoate ion and H^+ ion are 42 and 288.42 $ohm^{-1}\ cm^2\ eq^{-1}$ respectively. its degree of dissociation is

a) 39% **b)** 3.9% **c)** 0.35% **d)** 0.039%

Q38 What is $[H^+]$ of a solution that is 0.01 M in HCN and 0.02 M in NaCN (K_a for HCN = 6.2×10^{-10})

a) 3.1×10^{10} **b)** 6.2×10^{5} **c)** 6.2×10^{-10} **d)** 3.1×10^{-10}

Q39 Which of the following order of energies of molecular orbitals of N_2 is correct?

a) $(\pi 2p_y) < (\sigma 2p_z) < (\pi 2p_x^*) \approx (\pi 2p_y^*)$ **b)** $(\pi 2p_y) > (\sigma 2p_z) > (\pi 2p_x^*) \approx (\pi 2p_y^*)$

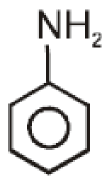
c) $(\pi 2p_y) < (\sigma 2p_z) > (\pi 2p_x^*) \approx (\pi 2p_y^*)$ **d)** $(\pi 2p_y) > (\sigma 2p_z) < (\pi 2p_x^*) \approx (\pi 2p_y^*)$

Q40 Riboflavin deficiency causes :

a) scurvy **b)** pellagra **c)** beri-beri **d)** cheilosis

Q41 Which of the following will not give four smell with $CHCl_3$ / KOH ?

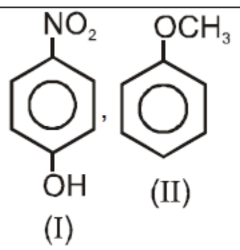
a) $CH_3–CH_2–NH–CH_3$ **b)** $CH_3–CH_2–CH_2–NH_2$ **c)**



d)

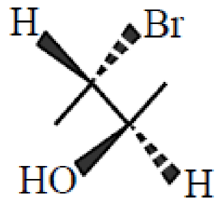
$$CH_3-\underset{}{\overset{CH_3}{\overset{|}{C}}}H-NH_2$$

Q42 Match the compounds of column-I with the reagent of column-II, which can distinguish between the compounds of column-I.

	Column-I		Column-II
(P)	$CH_3–C≡C–H$ (I), $CH_3–CH=O$ (II)	(1)	Tollen's reagent
(Q)	 (I), (II)	(2)	Lucas reagent
(R)	$CH_3–CH(OH)–CH_3$ (I), $CH_3–C(=O)–CH_3$ (II)	(3)	Neutral $FeCl_3$

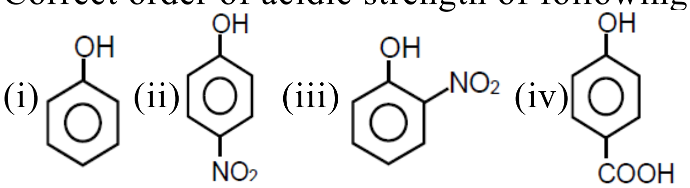
a) P–3; Q–2; R–1 **b)** P–1; Q–2; R–3 **c)** P–2; Q–1; R–3 **d)** P–1; Q–3; R–2

Q43 The correct IUPAC name of the compound is



a) (2R, 3R)-3-Bromo-2-butanol b) (2R, 3S)-3-Bromo-2-hydroxybutane
c) (2R, 3S)-3-Bromo-2-butanol d) (2S, 3R)-2-Bromo-3-butanol

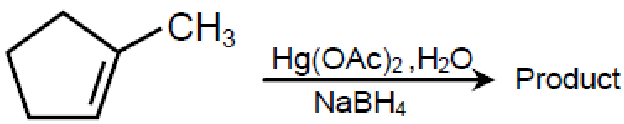
Q44 Correct order of acidic strength of following compound is :

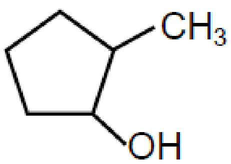


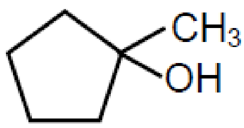
a) iv > ii > iii > i b) iii > ii > iv > i c) iv > iii > ii > i d) ii > iii > iv > i

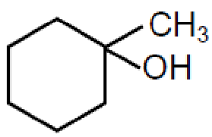
Q45 The main factor for shorter B–F bonds in BF_3 is :
a) Ionic- covalent resonance in BF_3 b) Large electronegativity of fluorine
c) pπ–pπ back bonding d) dπ–pπ back bonding

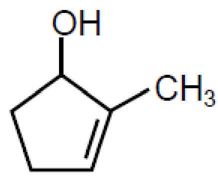
Q46



a) 

b) 

c) 

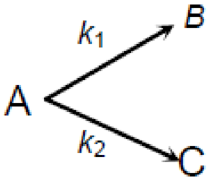
d) 

Q47 The acid D obtained through the following sequence of reactions is

$$C_2H_5Br \xrightarrow{Alc.KOH} A \xrightarrow[CCl_4]{Br_2} B \xrightarrow[(excess)]{KCN} C \xrightarrow{H_3O^+} D$$

a) Succinic acid b) Malonic acid c) Maleic acid d) Oxalic acid

Q48 A Substance undergoes first order decomposition. The decomposition follows two parallel first orderreactions as



$k_1 = 1.26 \times 10^{-4}\ s^{-1}$
$k_2 = 3.8 \times 10^{-5}\ s^{-1}$

The percentage distribution of B and C are

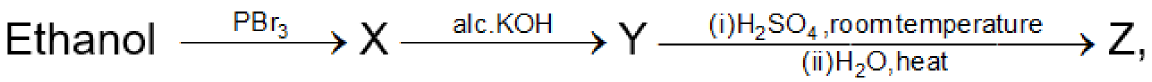
a) 75% B and 25% C b) 80% B and 20% C c) 60% B and 40% C
d) 76.83% B and 23.17% C

Q49 Treatment of ammonia with excess of ethyl chloride will yield

a) Diethyl amine b) Ethane c) Tetraethyl ammonium chloride

d) Ethyl amine

Q50 Consider the following reaction,



the product Z, is

a) $CH_2=CH_2$ b) $CH_3CH_2OCH_2CH_3$ c) $CH_3CH_2OSO_3H$ d) CH_3CH_2OH

Numerical

Q51 The volume occupied by 4.75 g of acetylene gas at 50°C and 740 mmHg pressure is _____ L. (Rounded off to the nearest integer) [Given R = 0.0826 L atm K^{-1} mol^{-1}]

Q52 C_6H_6 freezes at 5.5°C. The temperature at which a solution 10 g of C_4H_{10} in 200 g of C_6H_6 freeze is _______ °C. (The molal freezing point depression constant of C_6H_6 is 5.12°C/m.) (Rounded off to the nearest integer)

Q53 The solubility product of PbI_2 is 8.0×10^{-9}. The solubility of lead iodide in 0.1 molar solution of lead nitrate is $x \times 10^{-6}$ mol/L. The value of x is __________.
(Rounded off to the nearest integer)
[Given : $\sqrt2 = 1.41$]

Q54 Assuming ideal behaviour, the magnitude of log K for the following reaction at 25°C is $x \times 10^{-1}$. The value of x is _______. (Integer answer)
$3HC \equiv CH_{(g)} \rightleftharpoons C_6H_{6(\ell)}$
[Given: $\Delta_f G^o$ (HC $\equiv$ CH) = -2.04×10^5 J mol^{-1}; $\Delta_f G^o(C_6H_6)$ = -1.24×10^5 J mol^{-1}; R = 8.314 J K^{-1} mol^{-1}]

Q55 Number of amphoteric compound among the following is __________
(i) BeO (ii) BaO (iii) $Be(OH)_2$ (iv) $Sr(OH)_2$

Q56 For the reaction $A_{(g)} \rightarrow (B)_{(g)}$, the value of the equilibrium constant at 300 K and 1 atm is equal to 100.0. The value of $\Delta_r G$ for the reaction at 300 K and 1 atm in J mol^{-1} is – xR, where x is ______ (Rounded of to the nearest integer)
(R = 8.31 J mol^{-1} K^{-1} and ln 10 = 2.3)

Q57 A proton and a Li^{3+} nucleus are accelerated by the same potential. If λ_{Li} and λ_P denote the de Broglie wavelengths of Li^{3+} and proton respectively, then the value of ${\lambda_{Li} \over \lambda_P}$ is $x \times 10^{-1}$. The value of x is ____.
(Rounded off to the nearest integer)
(Mass of Li^{3+} = 8.3 mass of proton)

Q58 Gaseous cyclobutene isomerizes to butadiene in a first order process which has a 'k' value of $3.3 \times 10^{-4} s^{-1}$ at 153°C. The time in minutes it takes for the isomerization to proceed 40 % to completion at this temperature is _____.
(Rounded off to the nearest integer)

Q59 The equivalent weight of HCl in the given reaction is :
$K_2Cr_2O_7 + 14HCl \longrightarrow 2KCl + 2CrCl_3 + 3Cl_2 + H_2O$
(Report your answer in terms of nearest integer)

Q60 Total charge required (in F) for the oxidation of two moles Mn_3O_4 into MnO_4^{2-} in presence of alkaline medium is :

Mathematics

Single Choice Question

Q61 If a sin x + b cos (c + x) + b cos (c – x) = α, α > a, then the minimum value of | cosc | is :

a) $\sqrt{\frac{\alpha^2 - a^2}{b^2}}$ b) $\sqrt{\frac{\alpha^2 - a^2}{2b^2}}$ c) $\sqrt{\frac{\alpha^2 - a^2}{3b^2}}$ d) $\sqrt{\frac{\alpha^2 - a^2}{4b^2}}$

Q62 The remainder when $2^{30} \cdot 3^{20}$ is divided by 7 is :

a) 1 b) 2 c) 4 d) 6

Q63 The area (in sq. units) of the region $\{(x, y) \in R^2 \mid 4x^2 \leq y \leq 8x + 12\}$ is

a) $\frac{128}{3}$ b) $\frac{125}{3}$ c) $\frac{127}{3}$ d) $\frac{124}{3}$

Q64 If p, q, r are positive and are in A.P., in the roots of quadratic equation $px^2 + qx + r = 0$ are all real for

a) $\left|\frac{r}{p} - 7\right| \geq 4\sqrt{3}$ b) $\left|\frac{p}{r} - 7\right| \geq 4\sqrt{3}$ c) all p and r d) no p and r

Q65 How many words can be formed by rearranging the letters of the word "GENIUS" such that each word neither start with 'G' nor end with 'S' ?

a) 480 b) 600 c) 504 d) 720

Q66 If $\cos^{-1}\sqrt{p} + \cos^{-1}\sqrt{1-p} + \cos^{-1}\sqrt{1-q} = \frac{3\pi}{4}$, then the value of q is

a) 1 b) $\frac{1}{\sqrt{2}}$ c) $\frac{1}{3}$ d) $\frac{1}{2}$

Q67 If the value of the determinant $\begin{vmatrix} a & 1 & 1 \\ 1 & b & 1 \\ 1 & 1 & c \end{vmatrix}$ is positive, then (a, b, c > 0)

a) abc > 1 b) abc > –8 c) abc < –8 d) abc > –2

Q68 In a triangle ABC, if A is (1, 2) and the equations of the medians through B and C are x + y = 5 and x = 4 respectively then B must be :

a) (1, 4) b) (7, -2) c) (4, 1) d) (-2, 7)

Q69

$f(x) = x^6 - x - 1, x \in [1, 2]$. Consider the following statements :

(1) f is increasing on[1, 2] (2) f has a root in [1, 2]

(3) f is decreasing on [1, 2] (4) f has no root in [1, 2]

Which of the above are correct?

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

Q70

If eccentricity of conjugate hyperbola of the given hyperbola :

$\left|\sqrt{(x-1)^2+(y-2)^2}-\sqrt{(x-5)^2+(y-5)^2}\right| = 3$ is e′, then value of 8e′ is :

a) 12 b) 14 c) 17 d) 10

Q71 $\lim_{t\to 0}\dfrac{12^t-3^t-4^t+1}{\sqrt{2\cos t+7}-3}$ is equal to

a) $\log_e 12$ b) loge 3.$\log_e 4$ c) ($\log_e$ 3.loge $4)^{-1}$ d) $-6\log_e 3.\log_e 4$

Q72

Let f : R \(\rightarrow\) R be a function defined as $f(x) = \begin{cases} 5, & \text{if } x \le 1 \\ a+bx, & \text{if } 1 < x < 3 \\ b+5x, & \text{if } 3 \le x < 5 \\ 30, & \text{if } x \ge 5 \end{cases}$

Then, f is:

a) Continuous if a = –5 and b = 10 b) Continuous if a = 5 and b = 5

c) Continuous if a = 0 and b = 5 d) Not continuous for any values of a and b

Q73 Range of $f(x) = \sin^{-1}[x-1] + 2\cos^{-1}[x-2]$ ([·] denotes greatest integer function)

a) $\left\{-\dfrac{\pi}{2}, 0\right\}$ b) $\left\{\dfrac{\pi}{2}, 2\pi\right\}$ c) $\left\{\dfrac{\pi}{4}, \dfrac{\pi}{2}\right\}$ d) $\left\{\dfrac{3\pi}{2}, 2\pi\right\}$

Q74

Let $a_1, a_2, a_3, \ldots, a_{11}$ be real numbers satisfying $a_1 = 15$, $27 - 2a_2 > 0$ and $a_k = 2a_{k-1} - a_{k-2}$, for k = 3, 4, ..., 11. If $\dfrac{a_1^2+a_2^2+\ldots+a_{11}^2}{11} = 90$, then the value of $\dfrac{a_1+a_2+\ldots+a_{11}}{11}$ is equal to.

a) 0 b) 1 c) 5 d) 2

Q75

The value of the definite integral $\int_{-2}^{2} x^3 \ln\left(1^x+3^x+5^x+15^x\right)dx$ is equal to

a) $\dfrac{\ln 15}{4}$ b) $\dfrac{64}{5}\ln 15$ c) $\dfrac{32}{5}\ln 15$ d) $\dfrac{64}{5}\ln 30$

Q76

If $\int \frac{1-x^7}{x(1+x^7)} dx = a\log_e|x| + b\log_e|x^7+1| + c$, then value of a/b

a) $\frac{2}{7}$ b) $-\frac{2}{7}$ c) $\frac{7}{2}$ d) $-\frac{7}{2}$

Q77 The pair of lines whose direction cosines are given by the equations 3l + m + 5n =0 and 6mn –2nl + 5lm =0 are.

a) parallel b) perpendicular c) inclined at $\cos^{-1}\left(\frac{1}{6}\right)$ d) none of these

Q78 If $I = \int_0^1 \frac{dx}{1+x^{\frac{\pi}{2}}}$, then

a) $I = \log_e 2$ b) $I < \log_e 2$ c) $I = \frac{\pi}{4}$ d) $\log_e 2 < I < \frac{\pi}{4}$

Q79

AB is any chord of the circle $x^2 + y^2 - 6x - 8y - 11 = 0$ which subtends an angle $\frac{\pi}{2}$ at (1, 2). If locus of midpoint of AB is a circle $x^2 + y^2 - 2ax - 2by - c = 0$; then find the value of (a + b + c).

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

Q80 The solution of the differential equation, $x(x^2 + 3y^2)\,dx + y(y^2 + 3x^2)\,dy = 0$ is (Where c is an arbitrary constant)

a) $x^4 + y^4 + x^2y^2 = c$ b) $x^4 + y^4 + 3x^2y^2 = c$ c) $x^4 + y^4 + 6x^2y^2 = c$
d) $x^4 + y^4 + 9x^2y^2 = c$

Numerical

Q81 If T is the period of the function $f(x) = [8x + 7] + |\tan 2\pi x + \cot 2\pi x| - 8x$ (where [.] denotes the greatest integer function), then the value of T is________. **(Answer to be round off to nearest integer)**

Q82 A mapping is selected at random from all mappings $f : A \to A$ where set A = {1, 2, 3, ..., n}.

If the probability that mapping is injective is $\frac{3}{32}$, then the value of n is :

Q83 Find the absolute value of parameter t for which the area of the triangle whose vertices are A (–1,1,2); B (1,2,3) and C (t, 1,1) is minimum.

Q84 The mean of 9 observations is 15. If one more observation is added to the series, the mean
becomes 16. The value of 10th observation is

Q85 If $A=\left\{x \mid x \in N \text{ and } x<6\frac{1}{4}\right\}$ and $B=\left\{x \mid x \in N \text{and} x^2 \leq 5\right\}$.
Then the number of subsets of set A×(A \(\cap\) B) which contains exactly 3 elements, is

Q86 If \(% MathType!MTEF!2!1!+- %
feaahqart1ev3aaatCvAUfeBSjuyZL2yd9gzLbvyNv2CaerbbjxAHX %
garmWu51MyVXgatCvAUfKttLearyWqVvNCPvMCqnfaruavP1wzZbIt %
LDhis9wBH5garqqtubsr4rNCHbGeaGqiFCI8FfYJH8WrFfeuY-Hhbb %
a9v8qqaqFr0xc9pk0xbba9q8WqFfeaY-biLkVcLq-JHqpepeea0-as %
0Fb9pgeaYRXxe9vr0-vr0-vqpWqaaeaabaGaaiaacaqabeaadaabau %
aaaOqaaiaad2eacqGH9aqpdaWadaqaauaabeqadmaaaeaacaaIXaaa %
baGaam4yaaqaaiaaiodaaeaacaaIXaaabaGaaG4maaqaaiaaiodaae %
aacaaIYaaabaGaaGinaaqaaiaaisdaaaaacaGLBbGaayzxaaGaaiil % aiaad2eaaaa!455D!
M = \left[{\begin{array}{*{20}{c}} 1&c&3\\ 1&3&3\\ 2&4&4 \end{array}} \right],M\) is the adjoint of a 3 × 3 matrix N and det(N) = 4, then c is equal to

Q87 Let the equations of two ellipses be $E_1: \frac{x^2}{3}+\frac{y^2}{2}=1$ and $E_2: \frac{x^2}{16}+\frac{y^2}{b^2}=1$. If the product of their eccentricities is $\frac{1}{2}$, then the largest possible length of the minor axis of ellipse E_2 is

Q88 Let F(x) = f(x) g(x) h(x) for all real x, where f(x), g(x) and h(x) are differentiable functions. At some point x_0. $F'(x_0) = 21F(x_0)$, $f'(x_0) = 4f(x_0)$, $g'(x_0) = -7g(x_0)$ and $h'(x_0) = kh(x_0)$. Then k = _____.

Q89 If z_1 and z_2 are non zero solutions of equation $z^2+z=i\bar{z}$ where $i=\sqrt{-1}$, then $|z_1 + z_2|$ is equal to

Q90 Points A and B lie on the parabola $y = 2x^2 + 4x - 2$, such that origin is the mid-point of the line segment AB. If 'l' be the length of the line segment AB, then find the unit digit of l^2.

Answer Key

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**B**	**A**	**A**	**B**	**C**	**A**	**C**	**A**	**D**	**A**
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	**B**	**A**	**C**	**C**	**C**	**A**	**B**	**C**	**B**	**C**
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	**15**	**1**	**2**	**4**	**2**	**8**	**1**	**4**	**160**	**4**
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	**A**	**A**	**B**	**B**	**B**	**A**	**B**	**D**	**A**	**D**
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	**A**	**D**	**C**	**A**	**C**	**B**	**A**	**D**	**C**	**D**
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	**5**	**1**	**141**	**855**	**2**	**1380**	**2**	**26**	**85**	**20**
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	**D**	**B**	**A**	**B**	**C**	**D**	**B**	**B**	**A**	**D**
Que.	71	72	73	74	75	76	77	78	79	80
Ans.	**D**	**D**	**D**	**A**	**C**	**D**	**C**	**D**	**D**	**C**
Que.	81	82	83	84	85	86	87	88	89	90
Ans.	**0**	**4**	**2**	**25**	**220**	**11**	**16**	**24**	**2**	**8**