

Competishun

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

Date: 06/12/2024

Time: 3 hours

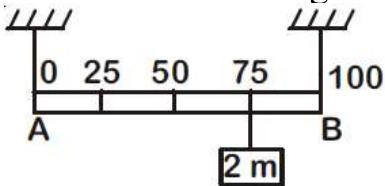
Max. Marks: 30

UTS-1_MT-7 (24-25)

Physics

Single Choice Question

- Q1** Shown in the figure is rigid and uniform one meter long rod AB held in horizontal position by two strings tied to its ends and attached to the ceiling. The rod is of mass 'm' and has another weight of mass 2 m hung at a distance of 75 cm from A. The tension in the string at A is



- a) 0.5 mg b) 2 mg c) 0.75 mg d) 1 mg

- Q2** A particle is connected with a string of length 'l' from a fixed point. If velocity of particle at lower most point is $\sqrt{3.5gl}$ find the minimum velocity of the particle in subsequent motion :-

- a) 0 b) \sqrt{lg} c) $\sqrt{\frac{lg}{4}}$ d) $\sqrt{\frac{lg}{8}}$

- Q3** A particle of mass m and charge q moves with a constant velocity v along the positive x direction. It enters a region containing a uniform magnetic field B directed along the negative z direction, extending from x = a to x = b. The minimum value of v required so that the particle can just enter the region x > b is :-

- a) $\frac{qbB}{m}$ b) $\frac{q(b-a)B}{m}$ c) $\frac{qaB}{m}$ d) $\frac{q(b+a)B}{2m}$

Q4 Reflecting surface of a mirror is parallel to the x-y plane. An incident ray parallel to a vector $\hat{A} = \frac{1}{2\sqrt{2}}\hat{i} + \frac{1}{2\sqrt{2}}\hat{j} - \frac{\sqrt{3}}{2}\hat{k}$, falls on the mirror. Identify the direction of reflected ray. Express your answer in terms of \hat{i} , \hat{j} and \hat{k} , where \hat{i} , \hat{j} and \hat{k} have thei usual meanings.

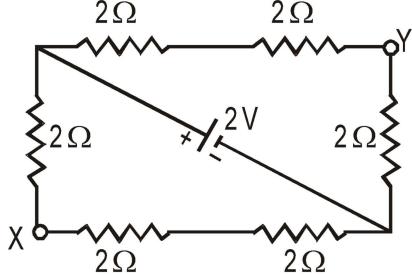
a) $\frac{1}{2\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j} + \frac{\sqrt{3}}{2}\hat{k}$

c) $\frac{1}{2\sqrt{2}}\hat{i} + \frac{1}{2\sqrt{2}}\hat{j} + \sqrt{3}\hat{k}$

b) $\frac{1}{2\sqrt{2}}\hat{i} + \frac{1}{2\sqrt{2}}\hat{j} + \frac{\sqrt{3}}{2}\hat{k}$

d) $\frac{1}{2\sqrt{2}}\hat{i} + \frac{1}{2\sqrt{2}}\hat{j} + \frac{\sqrt{3}}{2\sqrt{2}}\hat{k}$

Q5 $V_X - V_Y$ will be :



a) $2/3$

b) $4/3$

c) $8/9$

d) $5/8$

Q6 The heat (Q) supplied to a solid, which is otherwise thermally isolated from its surroundings, is plotted as a function of its absolute temperature, θ . It is found that they are related by the equation.

$Q = a\theta^2 + b\theta^4$ (a, b is constants). The heat capacity of the solid is given by

a) $a\frac{\theta^3}{3} + b\frac{\theta^5}{5}$

b) $a\theta + b\theta^3$

c) $a\frac{\theta}{3} + b\frac{\theta^3}{5}$

d) $2a\theta + 4b\theta^3$

Q7 Potential energy of a body of mass 'm' in a conservative force field can be expressed $U = \alpha x - \beta y$ as where x and y are position coordinates of the body. Acceleration of the body can be expressed as:

a) $\frac{\alpha^2 - \beta^2}{m}$

b) $\left[\frac{\alpha^2 + \beta^2}{m^2} \right]^{1/2}$

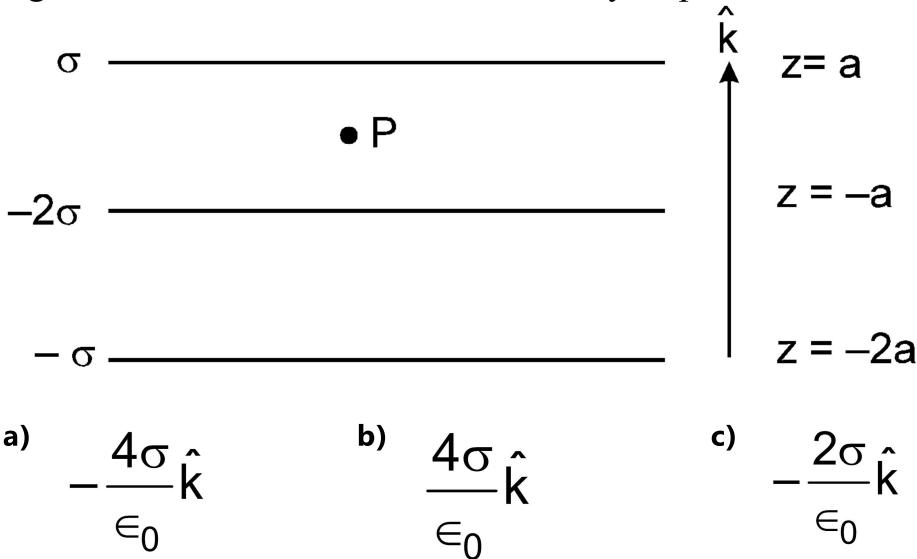
c) $\frac{\alpha - \beta}{m}$

d) $\frac{\alpha + \beta}{m}$

Q8 A heavy nucleus X having mass number 200 gets disintegrated into two small fragments Y and Z of mass number 80 and 120 respectively. If binding energy per nucleon for the parent atom X is 6.5 MeV and for daughter nuclei Y and Z are 7 MeV and 8 MeV respectively. Energy released in the decay will be

- a) 200 MeV b) 240 MeV c) 220 MeV d) 180 MeV

Q9 Three large parallel plates have uniform surface charge densities as shown in the figure. Find out electric field intensity at point P.

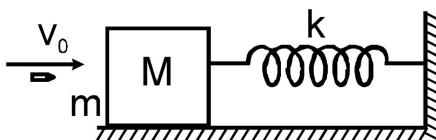


- a) $-\frac{4\sigma}{\epsilon_0} \hat{k}$ b) $\frac{4\sigma}{\epsilon_0} \hat{k}$ c) $-\frac{2\sigma}{\epsilon_0} \hat{k}$ d) $\frac{2\sigma}{\epsilon_0} \hat{k}$

Q10 An organ pipe closed at one end and open at another end has length 42 cm and diameter 10 cm. The air column in pipe vibrates in its second overtone with the maximum amplitude ΔP_0 . The pressure amplitude at a distance 24 cm from the open end of the tube is

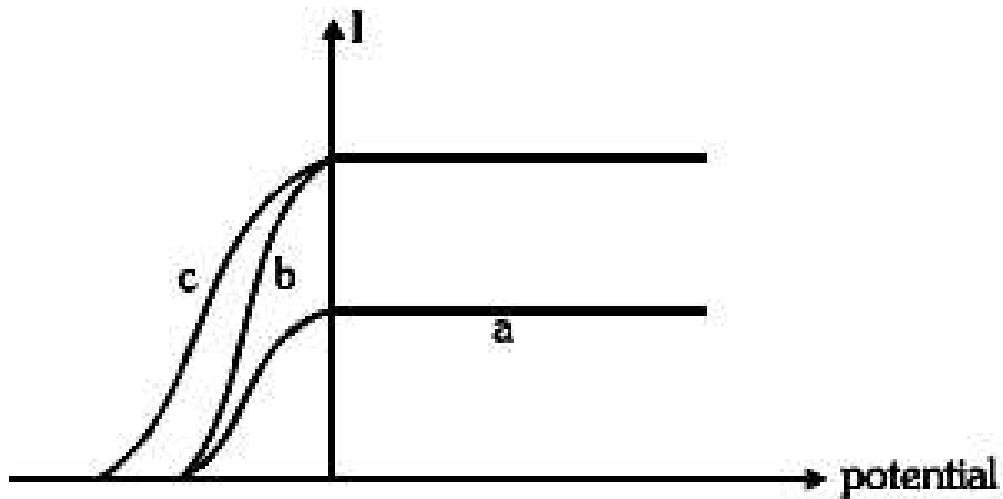
- a) $\frac{\Delta P_0}{2}$ b) $\frac{\Delta P_0}{\sqrt{2}}$ c) ΔP_0 d) $\frac{\sqrt{3}\Delta P_0}{2}$

Q11 A bullet of mass $m = 1\text{kg}$ strikes a block of mass $M = 2\text{kg}$ connected to a light spring of stiffness $k = 3\text{N/m}$ with a speed $V_0 = 3\text{m/s}$. If the bullet gets embedded in the block then.



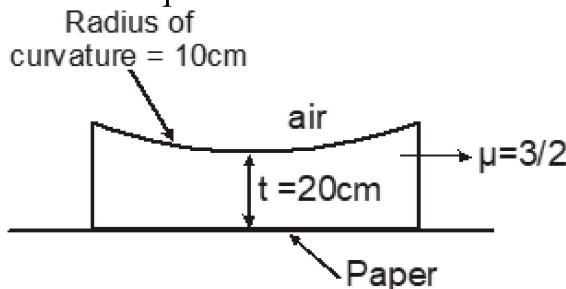
- a) linear momentum of bullet and block system is not conserved during impact because spring force is impulsive.
 b) linear momentum of bullet and block system is not conserved during impact because spring force is nonimpulsive.
 c) Maximum compression in the spring is 2m.
 d) The maximum compression in the spring is 1m.

- Q12** In photoelectric experiment the plot between anode potential and photoelectric current is shown in figure. Which of the following is correct ?



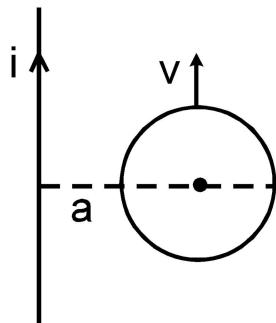
- a) Frequency of light corresponding to 'a' is same as that 'b' and is different for 'c'
 - b) Frequency of light corresponding to 'a' is different from 'b' but the intensities are same
 - c) Frequency of light corresponding to 'b' is same as that 'c' but intensities are different.
 - d) Frequency of light for all 'a', 'b' and 'c' are same
- Q13** When a certain metallic surface was illuminated by light of 300 nm the stopping potential is found to $3V_0$. When a wavelength of 600 nm is incident on the surface the stopping potential is found to be V_0 . Then the threshold wavelength for the metal would be :
- a) 1200 nm
 - b) 700 nm
 - c) 800 nm
 - d) 1000 nm
- Q14** Acceleration of a particle moving along a straight line is a function of velocity as $a = 2\sqrt{v}$. At $t = 2\text{s}$, its velocity $v = 16\text{ms}^{-1}$. Its velocity at $t = 3\text{s}$ will be
- a) 20 ms^{-1}
 - b) 25 ms^{-1}
 - c) 30 ms^{-1}
 - d) 22.5 ms^{-1}

- Q15** A planoconcave lens is placed on a paper on which a flower is drawn. How far above its actual position does the flower appear to be ?



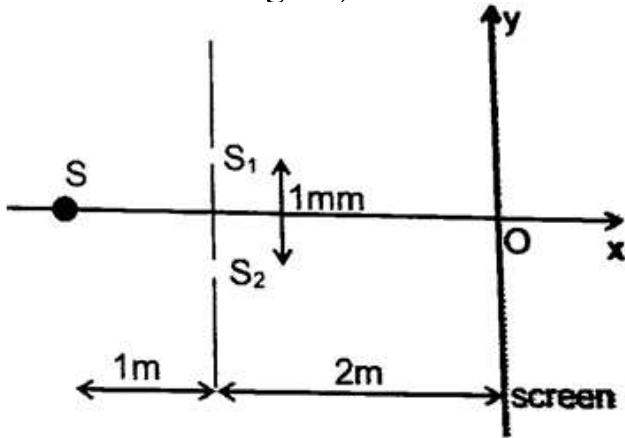
- a) 10 cm b) 12 cm c) 50 cm d) none of these

- Q16** A circular loop of radius r is moved with a velocity v as shown in the diagram. The work needed to maintain its velocity constant is :



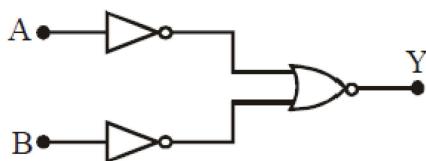
- a) $\frac{\mu_0 i v r}{2\pi a}$ b) $\frac{\mu_0 i v r}{2\pi(a+r)}$ c) $\frac{\mu_0 i v r}{2\pi} \ln\left(\frac{2r+a}{a}\right)$ d) zero

- Q17** In a young's double slit experiment set up source S of wavelength $\lambda = 500 \text{ nm}$ illuminates two symmetrically located slits S_1 and S_2 . The source S oscillates about its shown position parallel to the screen according to the equation $y = (0.5 \text{ mm}) \sin(\pi t)$. Find least value of time (t) at which its intensity becomes maximum at a point on the screen that is exactly in front of slits S_1 . (where t is time in second. Distance are as marked in the figure).



- a)** $\frac{1}{3}$ **b)** $\frac{1}{6}$ **c)** $\frac{1}{12}$ **d)** $\frac{1}{24}$
- Q18** A rigid container, containing 3 moles of an ideal diatomic gas is heated in such a way that the temperature of the gas increases to 400 K from 300 K. Also, one mole of the diatomic gas breaks into individual free atoms. Find the net heat transferred to the gas.
- a)** 950 R **b)** 450 R **c)** 800 R **d)** 400 R

- Q19** Which logic gate is represented by the following combination of logic gates –



- a)** OR **b)** NAND **c)** AND **d)** NOR

- Q20** The magnetic field of a plane electromagnetic wave is

$$\vec{B} = 3 \times 10^{-8} \sin[200\pi(y + ct)] \hat{i} T$$

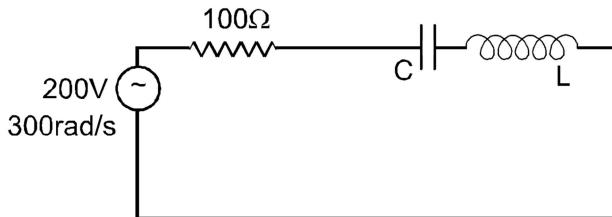
where $c = 3 \times 10^8 \text{ ms}^{-1}$ is the speed of light.

The corresponding electric field is

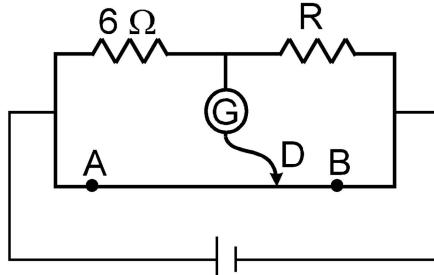
- a) $\vec{E} = -9 \sin[200\pi(y + ct)] \hat{k} V/m$
- b) $\vec{E} = 9 \sin[200\pi(y + ct)] \hat{k} V/m$
- c) $\vec{E} = -10^{-6} \sin[200\pi(y + ct)] \hat{k} V/m$
- d) $\vec{E} = 3 \times 10^{-8} \sin[200\pi(y + ct)] \hat{k} V/m$

Numerical

- Q21** In the LCR circuit shown if only L is removed, the current leads the supply voltage by 30° . If only C is removed, the current lags the voltage by 60° . The resonant frequency is $\frac{50x}{\sqrt{3}\pi}$ Hz, then write the value of 'x'.



- Q22** The meter-bridge wire AB shown in figure is 50 cm long. When AD = 30 cm, no deflection occurs in the galvanometer. Find R (in Ω).

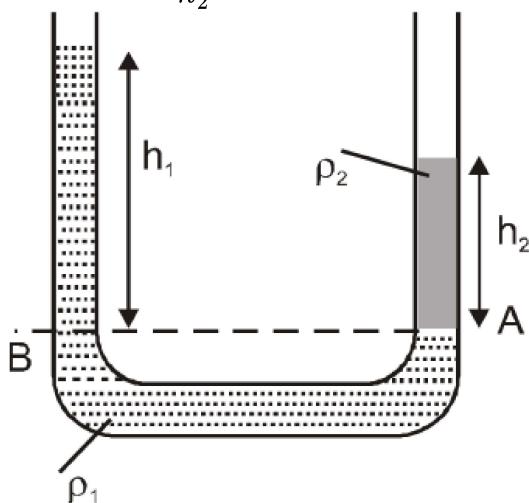


- Q23** In an experiment four quantities a, b, c and d are measured with percentage error 1%, 2%, 3% and 4% respectively. Quantity P is calculated as follows:

$$P = \frac{a^3 b^2}{cd}$$

% error in P is:

- Q24** Two immiscible liquids are poured in a U-tube having densities $\rho_1 = 1.0 \times 10^3 \text{ kg/m}^3$ and $\rho_2 = 3.0 \times 10^3 \text{ kg/m}^3$. Find the ratio of heights (of the liquids above their interface) $\frac{h_1}{h_2}$.



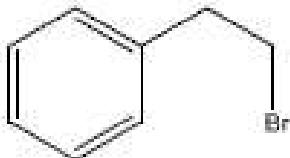
- Q25** A parallel capacitor of plate area $A = 4 \times 10^{-4} \text{ m}^2$ and separation between the plates $d = 1.1 \text{ mm}$ is connected across a cell of emf $V = 10V$. The space between the plates is completely filled with an insulating material of dielectric of constant $K = 100$. The polarisation of the dielectric material is, $k \times 10^{-19} \text{ C/m}^2$. Find the value of $5k$.

Chemistry

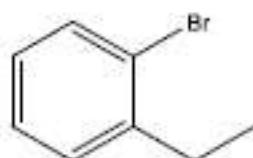
Single Choice Question

Q26 Compound 'Y' with molecular formula C_8H_9Br gives a precipitate on heating with alcoholic $AgNO_3$. Oxidation of 'Y' gives product 'Z' ($C_8H_6O_4$) which gives an anhydride upon heating.
Compound 'Y' is

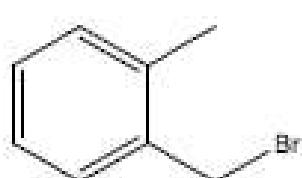
a)



b)



c)



d)



Q27 First electron gain enthalpy (in kJ/mol) of few elements are given below.

Elements	ΔH_{eg}
I	-60
II	-45
III	-328
IV	-295
V	+48

Answer the following questions on the basis of above data:

Which element may be an inert gas

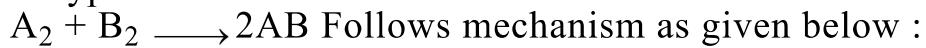
a) I

b) III

c) IV

d) V

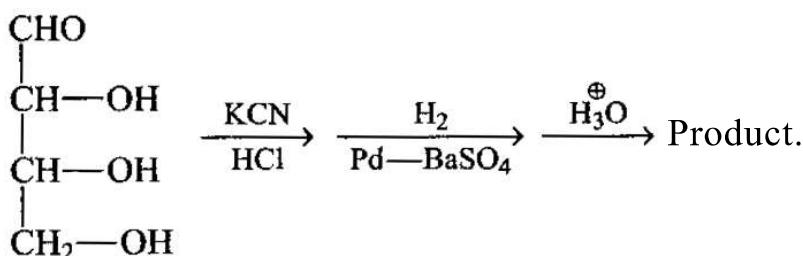
Q28 A hypothetical reaction :



The order of overall reaction is :

- a)** 2.5 **b)** 1 **c)** $3/2$ **d)** Zero

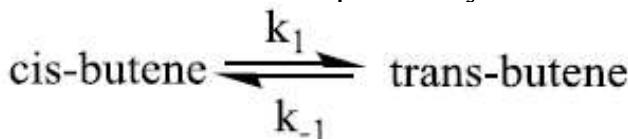
029 CHO



Find out final product:

- | | | | |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| a) $\begin{array}{c} \text{CH}_2\text{OH} \\ \\ (\text{CHOH})_3 \\ \\ \text{CH}_2\text{OH} \end{array}$ | b) $\begin{array}{c} \text{CHO} \\ \\ (\text{CH}-\text{OH})_3 \\ \\ \text{CH}_2-\text{OH} \end{array}$ | c) $\begin{array}{c} \text{COOH} \\ \\ (\text{CH}-\text{OH})_3 \\ \\ \text{CH}_2-\text{OH} \end{array}$ | d) $\begin{array}{c} \text{COOH} \\ \\ (\text{CHOH})_3 \\ \\ \text{COOH} \end{array}$ |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|

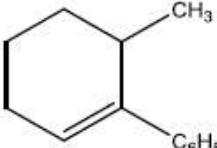
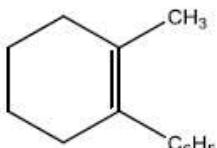
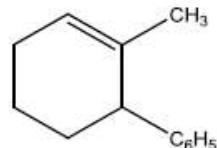
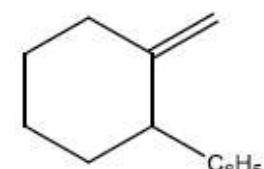
Q30 The equilibrium constants of the following isomerisation reaction at 400 K and 298 K are 2.07 and 3.42 respectively.



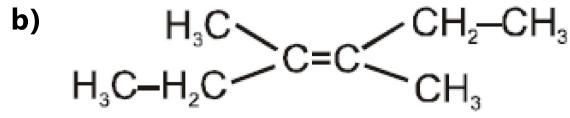
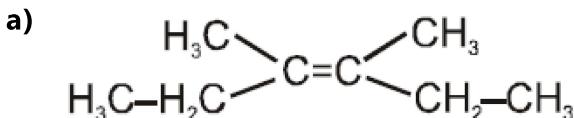
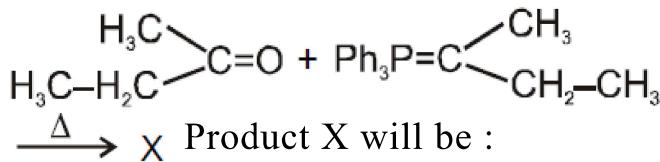
Which of the following is/are correct?

- I. The reaction is exothermic
 - II. The reaction is endothermic
 - III. At 400 K 50% of cis-butene and 50% of trans-butene are present at equilibrium
 - IV. Both at 298 K and 400 K, $k_1 = k_{-1}$

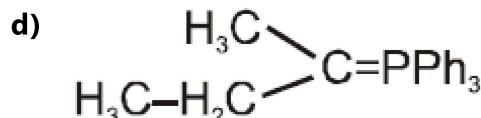
- a)** I and IV **b)** II and IV **c)** I and III **d)** I only

- Q31** Which of the following will have three stereoisomeric forms?
 (i) $[\text{Cr}(\text{NO}_3)_3(\text{NH}_3)_3]$ (ii) $\text{K}_3[\text{Co}(\text{C}_2\text{O}_4)_3]$ (iii) $\text{K}_3[\text{CoCl}_2(\text{C}_2\text{O}_4)_2]$ (iv) $[\text{CoBrCl}(\text{en})_2]$
- a) (iii) and (iv) b) (i), (iii) and (iv) c) (iv) only d) All four
- Q32** Sulphide ions reacts with sodium nitropruside giving a coloured solution. In the reaction, the oxidation state of iron :
 a) Changes from +2 to +4 b) Changes from +3 to +2
 c) Changes from +2 to +3 d) Does not change
- Q33** The product of the following reaction is
-
- a) 
- b) 
- c) 
- d) 
- Q34** The reaction that takes place during charging of the lead storage cell is given below
 $2\text{PbSO}_4(\text{s}) + 2\text{H}_2\text{O}(\ell) \rightarrow \text{Pb}(\text{s}) + \text{PbO}_2(\text{s}) + 2\text{H}_2\text{SO}_4(\text{aq})$
 If a current of 10.0 A is passed for 1.50 h for charging, the amount of PbSO_4 reacted is
 [Molar mass of lead = 207]
 a) 25.0 g b) 56.0 g c) 120.5 g d) 170.0 g
- Q35** A 0.001 molal solution of a complex $[\text{MA}_8]$ in water has the freezing point of -0.0054°C . Assuming 100% ionization of the complex salt and K_f for $\text{H}_2\text{O} = 1.86 \text{ km}^{-1}$, write the correct representation for the complex
 a) $[\text{MA}_8]$ b) $[\text{MA}_7]\text{A}$ c) $[\text{MA}_6]\text{A}_2$ d) $[\text{MA}_5]\text{A}_3$
- Q36** The thermal stability of the hydrides of group 15 follows the order:
 a) $\text{NH}_3 < \text{PH}_3 < \text{AsH}_3 < \text{SbH}_3 < \text{BiH}_3$ b) $\text{NH}_3 > \text{PH}_3 > \text{AsH}_3 > \text{SbH}_3 > \text{BiH}_3$
 c) $\text{PH}_3 > \text{NH}_3 > \text{AsH}_3 > \text{SbH}_3 < \text{BiH}_3$ d) $\text{AsH}_3 < \text{PH}_3 > \text{SbH}_3 > \text{BiH}_3 > \text{NH}_3$

- Q37** Optically pure 2-butanol has a specific rotation of +13.52 degrees. A synthesized and purified sample of 2-butanol has the observed specific rotation of +6.76 degrees. The correct statement based on this observation is
- a) the sample is completely racemized
 - b) 25% of the sample is racemic
 - c) 50% of the sample is racemic
 - d) 6.76% of the sample is racemic
- Q38** How many ml water should be added to 100ml HCl solution ($d = 1.5 \text{ g/ml}$) 80% by wt. to make it a solution of 40% by wt. of density = 1 g/ml.
- a) 100 ml
 - b) 300 ml
 - c) 200 ml
 - d) none of these
- Q39** A student adds 'x' g of iron (Fe) powder to dil. HCl and measures the work done by the reaction between HCl and the added Fe to be 1000 J . If the experiment was conducted at a constant pressure of 1 atm at 27°C, mass of Fe powder added is: [Molar mass Fe = 56]
- a) 22.4 g
 - b) 2.24 g
 - c) 11.2 g
 - d) 1.12 g
- Q40** Aryl halides are less reactive towards nucleophilic substitution reactions as compared to alkyl halides due to
- a) The formation of less stable carbocation
 - b) Shorter carbon halogen bond than usual
 - c) sp^2 -hybridized carbon attached to the halogen
 - d) All of the above
- Q41** In which of the following, all the bond lengths are not the same?
- I. IF_4^+ II. BF_4^- III. SF_4 IV. TeCl_4
- a) I, II , IV
 - b) II, III, IV
 - c) I, III, IV
 - d) I, II, III
- Q42** When a 20 mL of 0.08 M weak base BOH is titrated with 0.08 HCl , the pH of the solution at the end point is 5. What will be the pOH if 10 mL of 0.04 M NaOH is added to the resulting solution?
(Given : $\log 2 = 0.30$ and $\log 3 = 0.48$)
- a) 5.40
 - b) 5.88
 - c) 4.92
 - d) None of these

Q43

c) Both (1) and (2)



Q44 For the conversion of benzene into m-chlorobenzoic acid, the correct sequence of reagents is :

a) (i) $\text{C}_2\text{H}_5\text{Cl}$, AlCl_3 (ii) Cl_2 , Fe
 (iii) KMnO_4 , H^+, Δ

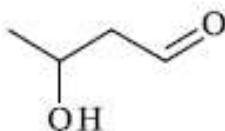
b) (i) CO, HCl , AlCl_3 (ii) Cl_2 , Fe
 (iii) KMnO_4 , H^+, Δ

c) (i) Cl_2 , AlCl_3 (ii) $\text{C}_2\text{H}_5\text{Cl}$, AlCl_3
 (iii) KMnO_4 , H^+, Δ

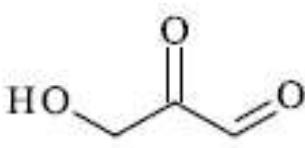
d) (i) HCOOH , AlCl_3 (ii) Cl_2 , Fe

Q45 Compound 'Y' (molar mass = 88.12 g mol^{-1}) containing 54.52% carbon, 9.17 % hydrogen and 36.31% oxygen gives a reddish-brown precipitate in Fehling's test. 'Y' is

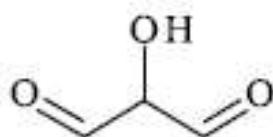
a) None of these



c)



d)



Numerical

Q46 In Duma's method of estimation of nitrogen, 0.1840 g of an organic compound gave 30 mL of nitrogen collected at 287 K and 758 mm of Hg pressure. The percentage composition of nitrogen in the compound is _____. (Round off to the Nearest Integer). [Given : Aqueous tension at 287 K = 14 mm of Hg]

Q47 The number of orbitals with $n = 5$, $m_l = +2$ is _____. (Round off to the Nearest Integer).

Q48 The standard enthalpies of formation of Al_2O_3 and CaO are $-1675 \text{ kJ mol}^{-1}$ and -635 kJ mol^{-1} respectively.

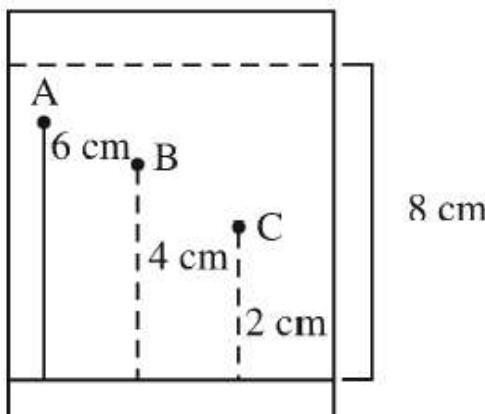
For the reaction

$3\text{CaO} + 2\text{Al} \rightarrow 3\text{Ca} + \text{Al}_2\text{O}_3$ the standard reaction enthalpy $\Delta_rH^0 = \text{_____ kJ}$.

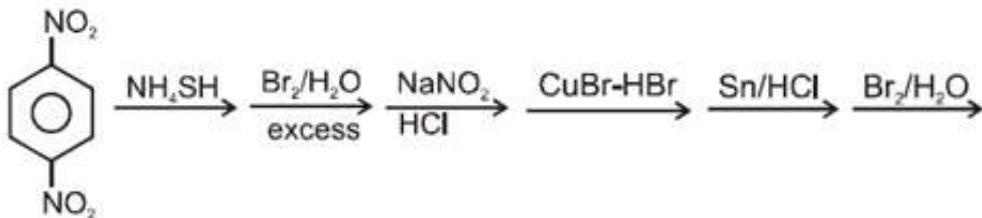
If your answer is X then what will be the value of $\frac{X}{10}$.

(Round off to the Nearest Integer).

Q49 Three organic compounds A, B and C were allowed to run in thin layer chromatography using hexane and gave the following result (see figure). The R_f value of the least polar compound is $\text{_____} \times 10^{-2}$



Q50



Major end product.

Find the total number of halogen atoms present in the major end product :

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15/21

Mathematics

Single Choice Question

- Q51** 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)** $b\sqrt{(2a^2 - 2b^2)}$

- Q52** 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
- Q53** If $a \in (-20, 0)$ 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)** $\frac{13}{20}$

- Q54** If $1, z_1, z_2, \dots, z_{n-1}$ are the n^{th} roots of unity then the value of $\frac{1}{3-z_1} + \frac{1}{3-z_2} + \dots + \frac{1}{3-z_{n-1}}$ is equal to
- a)** $\frac{n \cdot 3^{n-1}}{3^n - 1} + \frac{1}{2}$ **b)** $\frac{n \cdot 3^{n-1}}{3^n - 1} - 1$ **c)** $\frac{n \cdot 3^{n-1}}{3^n - 1} + 1$ **d)** $\frac{n \cdot 3^{n-1}}{3^n - 1} - \frac{1}{2}$

- Q55** 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

Q56

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 $y(\sqrt{2}) = \alpha\log_e(\sqrt{\alpha} + \beta) + \beta - \sqrt{\gamma}$, $\alpha, \beta, \gamma \in \mathbb{N}$

then $\alpha\beta\gamma$ is equal to ____.

- a) 5 b) 6 c) 3 d) 2

Q57

Let $f(x) = \lim_{n \rightarrow \infty} \frac{1}{\left(\frac{3}{\pi} \tan^{-1} 2x\right)^{2n} + 5}$ 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) $|2x| \leq \sqrt{3}$

Q58 The range of the function $f(x) = (1 + \sec^{-1} x)(1 + \cos^{-1} x)$ is

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

Q59 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) $\frac{\sqrt{29}}{2}$

Q60

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

Q61

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

Q62 $2f\left(\frac{x}{2}\right) + 3f\left(\frac{2-x}{3}\right) = g(x)$, $0 < x < 3$, $f''(x) > 0$ then $g(x)$ is strictly increasing in

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

Q63 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 ____.

- a) 6 b) 7 c) 8 d) 9

Q64 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) $\left(\frac{2}{\sqrt{5}}, \frac{1}{\sqrt{5}}\right)$

Q65 Area bounded by the region $R \equiv \{(x, y) : y^2 \leq x \leq |y|\}$ is

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

Q66 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

Q67 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) $2\sqrt{2}$

Q68 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

Q69 A ratio of the 5th term from the beginning to the 5th 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) $4(36)^{\frac{1}{3}} : 1$

Q70 Let R be a relation from the set $\{1, 2, 3, \dots, 60\}$ to itself such that $R = \{(a, b) : b = pq, \text{ where } p, q \geq 3 \text{ are prime numbers}\}$. Then, the number of elements in R is :

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

Numerical

Q71 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

Q72 A function f from integers to integers is defined 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

Q73 If $f(x) = x^n$, $n \in \mathbb{N}$, then the value of $f(1) - \frac{f'(1)}{1!} + \frac{f''(1)}{2!} - \frac{f'''(1)}{3!} + \dots + (-1)^n \frac{f^n(1)}{n!}$ is

Q74 If $A = \begin{bmatrix} 1 & -1 & 1 \\ 0 & 2 & -3 \\ 2 & 1 & 0 \end{bmatrix}$, $B = (\text{adj } A)$ and $C = 5A$, then $\frac{|\text{adj } B|}{|C|} =$

Q75 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

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20/21

Answer Key

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	D	D	B	B	A	D	B	C	C	D
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	D	A	A	B	B	D	B	A	C	A
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	3	4	14	3	398	C	D	C	B	D
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	A	D	C	D	C	B	C	C	A	D
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	C	B	C	B	A	19	3	23	75	5
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	B	D	D	D	C	B	A	C	A	D
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	B	C	D	B	C	D	B	D	D	B
Que.	71	72	73	74	75					
Ans.	45	6	0	1	0					