COMEDK UGET 2025 Memory Based Question Paper PDF

Physics

Question 1

The solution of $(x + \log y)dy + ydx = 0$ **when** $y(0) = 1$ **is**

Options:

A. $y(x - 1 + \log y) + 1 = 0$

B. $xy + y\log y + 1 = 0$

C. $xy = y\log y - y - 1$

D. $y(x + 1 + \log y) - 1 = 0$

Question 2

The order of the differential equation $\frac{d}{dx}\left[\left(\frac{dy}{dx}\right)^3\right] = 0$ **is**

Options:

A. not defined

B. 1

C. 2

D. 3

Question 3

Find the value of $\lim_{h\to 0} \frac{(a+h)^2 \sin(a+h) - a^2 \sin a}{h}$

Options:

A. $-a^2 \sin a$

B. 0

C. 1

D. $a^2 \cos a + 2a \sin a$

Question 4

$0.2 + 0.22 + 0.022 + \ldots\ldots\ldots\ldots$ **up to** n **terms is equal to**

Options:

A. $\frac{2}{9} - \frac{2}{81}\left(1 - 10^{-n}\right)$

B. $\frac{2}{9}\left[n - \frac{1}{9}\left(1 - 10^{-n}\right)\right]$

C. $\frac{2}{9}\left(1 - 10^{-n}\right)$

D. $\frac{n}{9}\left(1 - 10^{-n}\right)$

Question 5

The solution set of the system of inequalities $5 - 4x \leq -7$ or $5 - 4x \geq 7, x \in R$ is

Options:

A. $(-\infty, -\frac{1}{2}) \cap [3, \infty)$

B. $(-\infty, -\frac{1}{2}) \cup (3, \infty)$

C. $(-\infty, -\frac{1}{2}] \cap (3, \infty)$

D. $(-\infty, -\frac{1}{2}] \cup [3, \infty)$

Question 6

$-\frac{2\pi}{5}$ is the principal value of

Options:

A. $\sin^{-1}[\sin(\frac{7\pi}{5})]$

B. $\tan^{-1}[\tan(\frac{7\pi}{5})]$

C. $\cos^{-1}[\cos(\frac{7\pi}{5})]$

D. $\sec^{-1}[\sec(\frac{7\pi}{5})]$

Question 7

The digits of a three-digit number taken in an order are in geometric progression. If one is added to the middle digit, they form an arithmetic progression. If 594 is subtracted from the number, then a new number with the same digits in reverse order is formed. The original number is divisible by

Options:

A. 19

B. 11

C. 421

D. 4

Question 8

The least value of ' a ' such that the function $x^2 + ax + 1$ is increasing on $[1, 2]$ is

Options:

A. 4

B. 2

C. -2

D. 1

Question 9

Three fair dice are thrown. What is the probability of getting a total of 15 given that they exhibit three different numbers that are in arithmetic progression?

Options:

A. $\frac{1}{8}$

B. $\frac{1}{6}$

C. $\frac{1}{4}$

D. $\frac{1}{2}$

Question 10

The variance of 25 observations is 8 . If each observation is multiplied by 3 , then the new variance of the resulting observations is

Options:

A. 8

B. $\frac{8}{9}$

C. 24

D. 72

Question 11

P is a point on the line joining the points $(3, 5, -1)$ **and** $(6, 3, -2)$**. If** y **coordinate of point P is 2 , then** x **coordinate will be**

Options:

A. -5

B. $\frac{3}{2}$

C. $\frac{15}{2}$

D. $\frac{9}{2}$

Question 12

If $\vec{a}, \vec{b}, \vec{c}$ **are three vectors such that** $\vec{a} \neq 0$ **and** $\vec{a} \times \vec{b} = 2(\vec{a} \times \vec{c})$, $|\vec{a}| = |\vec{c}| = 1, |\vec{b}| = 4$ **and** $|\vec{b} \times \vec{c}| = \sqrt{15}$ **if** $\vec{b} - 2\vec{c} = \lambda \vec{a}$ **then** λ^2 **equals :**

Options:

A. -4

B. 16

C. 1

D. 4

Question 13

The general solution of the differential equation $(x - y)dy = (x + y)dx$ is

Options:

A. $\tan^{-1}\left(\frac{y}{x}\right) = c\sqrt{x^2 + y^2}$

B. $\tan^{-1}\left(\frac{y}{x}\right) = x^2 + y^2 + c$

C. $e^{\tan^{-1}\left(\frac{y}{x}\right)} = \frac{c\sqrt{x^2+y^2}}{x}$

D. $e^{\tan^{-1}\left(\frac{y}{x}\right)} = c\sqrt{x^2 + y^2}$

Question 14

A line L_1 passes through the points $(h, k), (1, 2)$ and $(-3, 4)$. The points $(4, 3)$ and (h, k) lie on the line L_2. Given $L_1 \perp L_2$ then $(k - h)$ equals to

Options:

A. 2

B. $\frac{1}{2}$

C. -2

D. 0

Question 15

Let M be the set of all 2×2 matrices with entries from the set R of real numbers. Then the function $f: M \to R$ defined by $f(A) = |A|$ for every $A \in M$ is

Options:

A. neither one-one nor onto

B. one-one but not onto

C. onto but not one-one

D. one-one and onto

Question 16

The sum of three numbers is 6 . Twice the third number, when added to the first number gives 7 , On adding the sum of the second and third numbers to thrice the first number, we get 12 . The above situation can be represented in matrix form as $AX = B$. Then the $|\text{adj } A|$ is equal to

Options:

A. -4

B. 4

C. -64

D. 16

Question 17

$\int \frac{1}{\sqrt{9+8x-x^2}}\,dx = \varphi(x) + c$ **then** $\varphi(x) =$

Options:

A. $\frac{1}{5}\sin^{-1}\left(\frac{x-4}{5}\right)$

B. $\sin^{-1}\left(\frac{x-4}{5}\right)$

C. $\frac{1}{10}\log\frac{4-x}{4+x}$

D. $\log\frac{4-x}{4+x}$

Question 18

A person writes four letters and address four envelopes. If the letters are placed in the envelopes at random, then the probability that not all letters are placed in the right envelope is

Options:

A. $\frac{15}{24}$

B. $\frac{11}{24}$

C. $\frac{23}{24}$

D. $\frac{1}{24}$

Question 19

$\int \tan^2\left(5 - \frac{x}{2}\right)dx =$

Options:

A. $-\frac{1}{2}\tan\left(5 - \frac{x}{2}\right) - x + c$

B. $-2\tan\left(5 - \frac{x}{2}\right) + c$

C. $\tan\left(5 - \frac{x}{2}\right) + c$

D. $-2\tan\left(5 - \frac{x}{2}\right) - x + c$

Question 20

If $f(x) = \left(\frac{3+x}{1+x}\right)^{2+3x}$**, then** $f'(0) =$

Options:

A. $12 + \log 3$

B. $-12 + 3\log 3$

C. $-\frac{4}{3} + 3\log 3$

D. $-12 + 27\log 3$

Question 21

If $A(t) = \begin{bmatrix} \cos t & \sin t \\ -\sin t & \cos t \end{bmatrix}$ **then the product of** $A(t)$ **and** $A(-t)$ **is**

Options:

A. Identity matrix

B. $A^2(t)$

C. Null matrix

D. $A^2(-t)$

Question 22

If $A = \begin{bmatrix} 1 & -2 \\ 4 & 5 \end{bmatrix}$; $f(t) = t^2 - 3t + 7$ **then** $f(A) + \begin{bmatrix} 3 & 6 \\ -12 & -9 \end{bmatrix}$ =

Options:

A. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

B. $\begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$

C. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

D. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Question 23

Codes used for vehicle identification consists of two distinct English alphabets followed by two distinct digits from 1 to 9 . How many of them end with an even number.

Options:

A. 10400

B. 2600

C. 20800

D. 5200

Question 24

Equation of a circle whose area is 154 sq units and having $2x - 3y + 12 = 0$ and $x + 4y - 5 = 0$ as diameters is

Options:

A. $x^2 + y^2 + 6x - 4y + 36 = 0$

B. $x^2 - y^2 + 6x - 4y - 36 = 0$

C. $x^2 + y^2 - 6x + 4y - 36 = 0$

D. $x^2 + y^2 + 6x - 4y - 36 = 0$

Question 25

If $y = \sqrt{\frac{x}{a}} + \sqrt{\frac{a}{x}}$, then $2xy\frac{dy}{dx}$ is equal to

Options:

A. $x + \frac{a}{x}$

B. $\frac{x^2+a^2}{ax}$

C. $\frac{x}{a} - \frac{a}{x}$

D. $\frac{a}{x} - \frac{x}{a}$

Question 26

Let A and B be two events such that one of the two events must occur. Given that the chance of occurrence of A is $\frac{2}{3}$ the chance of occurrence of B, then odds in favour of B is

Options:

A. 3 : 5

B. 2 : 5

C. 3 : 2

D. 2 : 3

Question 27

For two matrices A and B, given that $A^{-1} = \frac{1}{8}B$ then inverse of $(8A)$ is

Options:

A. $\frac{1}{8}B$

B. 8 B

C. $\frac{1}{64}B$

D. B

Question 28

Distance of the point $(-2, 3)$ from the line $12x - 5y - 2 = 0$ is $\frac{41}{k}$. Then the value of k is

Options:

A. $\sqrt{134}$

B. $\sqrt{13}$

C. 13

D. 1

Question 29

If $\sin A + \sin B = -\frac{21}{65}$, $\cos A + \cos B = -\frac{27}{65}$ π

Options:

A. $\frac{3}{\sqrt{130}}$

B. $\frac{6}{65}$

C. $-\frac{6}{65}$

D. $-\frac{3}{\sqrt{130}}$

Question30

If $A = \begin{bmatrix} 0 & 1 & -2 \\ -1 & 0 & 3 \\ 2 & -3 & 0 \end{bmatrix}$ **then** A^{-1}

Options:

A. equal to $-\frac{1}{12}(\text{adj } A)$

B. equal to -12

C. equal to $\frac{1}{12}(\text{adj } A)$

D. doesn't exit

Question 31

Area of the region bounded by the curve $y = \sin\left(\frac{x}{2}\right)$ between -4π and 0 is

Options:

A. 4 sq units

B. 8 sq units

C. 6 sq units

D. 1 sq units

Question 32

$\int \log x^2 dx =$

Options:

A. $\log x^2 + x + c$

B. $x \log x^2 - 1 + c$ **C.**

$x \log x^2 + x + c$ **D.** x

$\log x^2 - 2x + c$

Question33

The value of λ for which the angle between lines $\vec{r} = \hat{i} + \hat{j} + \hat{k} + p(2\hat{i} + \hat{j} + 2\hat{k})$ and $\vec{r} = (1+q)\hat{i} + (1+q\lambda)\hat{j} + (1+q)\hat{k}$ is $\frac{\pi}{2}$

Options:

A. −4

B. 2

C. −2

D. 4

Question 34

The value of $\frac{1}{2\sin 10^\circ} - 2\sin 70^\circ$ is

Options:

A. 0

B. 2

C. $-\frac{3}{2}$

D. 1

Question 35

If two vertices of a triangle are $(3, -2)$ and $(-2, 3)$ and its orthocentre is $(-6, 1)$. Then the difference between ordinate and abscissa of the third vertex of the triangle is

Options:

A. 2

B. 5

C. −5

D. 7

Question 36

The area bounded by the parabola $y^2 = 36x$ and its latus rectum is

Options:

A. 216 sq units

B. 108 sq units

C. 27 sq units

D. 54 sq units

Question 37

If $n(A) = 3$ and $n(B) = 7$ and $A \subseteq B$ then the number of elements in $A \cap B$ is equal to

Options:

A. 7

B. 10

C. 0

D. 3

Question 38

If $y = \sin^{-1}\left(\frac{1}{\sqrt{x+1}}\right)$ then $\frac{dy}{dx} =$

Options:

A. $\frac{1}{2\sqrt{1-x}}$

B. $\frac{1}{2\sqrt{x}(1+\sqrt{x})}$

C. $\frac{1}{2x(1+\sqrt{x})}$

D. $-\frac{1}{2\sqrt{x}(1+x)}$

Question 39

$\int_0^{\pi} \frac{e^{\cos x}}{e^{\cos x}+e^{-\cos x}} dx$ is equal to

Options:

A. π

B. 2π

C. $\frac{\pi}{4}$

D. $\frac{\pi}{2}$

Question 40

The range of x for which the equation $\sin^{-1}\left(\frac{2x}{1+x^2}\right) = 2\tan^{-1}x$ holds true

Options:

A. $|x| \leq 1$

B. $\forall x \in R$

C. $x \geq 0$

D. $|x| \geq 1$

Question 41

A spherical snowball is melting such that its volume is decreasing at the rate of $1\ \text{cm}^3/\text{min}$. The rate at which the diameter is decreasing when the diameter is 10 cm is

Options:

A. $\frac{11}{75\pi}$ cm/min

B. $\frac{1}{50\pi}$ cm/min

C. $\frac{2}{75\pi}$ cm/min

D. $\frac{1}{25\pi}$ cm/min

Question 42

For a given Linear Programming problem, the objective function is

$z = 3x + 2y$

Subject to constraints are

$4x + 3y \leq 60$
$x \geq 3$
$y \leq 2x$
$y \geq 0$

P is one of the corner points of the feasible region for the given Linear Programming problem. Then the coordinate of P is

Options:

A. (3, 6)

B. (0, 20)

C. (0, 0)

D. (12, 6)

Question 43

The curve $ax^3 + bx^2 + cx + d$ has a point of minima at $x = 1$, then

Options:

A. $3a + b < 0$

B. $3a + b > 0$

C. $3a + b = 0$

D. $a + 3b > 0$

Question 44

If $\tan x^\circ \tan 2^\circ \tan 3^\circ \ldots\ldots\ldots\ldots \tan 88^\circ \tan y^\circ = 1$ **then** $\cot(x + y) =$

Options:

A. 0

B. 1

C. $\frac{1}{2}$

D. Undefined

Question 45

Vasant and Jothi play a game with a coin. Vasant stakes ₹ 1 and throw the coins four times. If he throws four heads, he gets his stake and ₹3 from Jothi. If he throws only three heads and they are consecutive, he gets his stake and ₹2 from Jothi. If he throws only two heads and they are consecutive, he gets his stake and ₹1 from Jothi. In all other cases Jothi takes the stake money. Find the expectation of Vasant's gain.

Options:

A. $-\frac{5}{8}$

B. 0

C. 1

D. $\frac{5}{8}$

Question 46

The solution of the differential equation $\frac{dy}{dx} + y \log y \cot x = 0$ **is**

Options:

A. $\cos x \log y = c$

B. $\log y = c \sin x$ **C**

. $\sin x \log y = c$ **D.**

$y \sin x = c$

Question 47

A shopkeeper sells three varieties of fruit juice. He has a large number of bottles of same size of each variety. The number of different ways of displaying all the three varieties on the shelf with 5 places in a row and each display must have at least one bottle of each variety is

Options:

A. 150

B. 120

C. 60

D. 90

Question 48

The value of $\lim_{x \to 0} \frac{(1-x)^n - 1}{x} =$

Options:

A. n

B. 0

C. −n

D. 1

Question 49

If $f(x) = \begin{cases} \frac{1-x^m}{1-x} & \text{if } x \neq 1 \\ 2m-1 & \text{if } x = 1 \end{cases}$ **and the function is discontinuous at** $x = 1$**, then**

Options:

A. $m = 1$

B. $m \neq \frac{1}{2}$

C. $m = \frac{1}{2}$

D. $m \neq 1$

Question 50

$\int \frac{dx}{(x+2)(x^2+1)} = p\log|x+2| + q\log\ x^2+1\ + r\tan^{-1}x + c$ **then** $p+q+r =$

Options:

A. $\frac{2}{5}$

B. $\frac{1}{2}$

C. $\frac{7}{10}$

D. 16

Question 51

Let R be a relation on natural numbers defined by $x + 2y = 8, x, y \in N$**. The domain of R is**

Options:

A. $\{2, 4, 6, 8\}$

B. $\{2, 4, 6\}$

C. $\{2, 4, 8\}$

D. $\{1, 2, 3\}$

Question 52

Oil from a conical funnel is dripping at the rate of 5 cm radius and height of the funnel are 10 cm and 20 cm respectively, then the rate at which the oil level drops when it is 5 cm from the top is

$^3/s$. **If the**

Options:

A. $\frac{8}{45\pi}$ cm/s

B. $-\frac{2\pi}{45}$ cm/s

C. $-\frac{4\pi}{45}$ cm/s

D. $-\frac{4}{45\pi}$ cm/s

Question 53

If the third and fourth terms in the expansion $(2x + \frac{1}{8})^{10}$ **are equal, then the value of** x **is** _____

Options:

A. $\frac{1}{8}$

B. $\frac{2}{7}$

C. $\frac{1}{6}$

D. $\frac{8}{3}$

Question 54

Identify the correct statement

Options:

A. $A \cup A' = \emptyset$

B. $A - B = A' \cap B$

C. $(A \cup B)' = A' \cup B'$

D. $A \subseteq B \Rightarrow B' \subseteq A'$

Question 55

If $\frac{x-1}{3+i} + \frac{y-1}{3-i} = i$ then $(y, x) =$

Options:

A. $(-6, -4)$

B. $(-4, -6)$

C. $(6, -4)$

D. $(-4, 6)$

Question 56

A line L_1 passing through the point A with position vector $= 4\hat{i} + 2\hat{j} + 2\hat{k}$ is parallel to the vector $\vec{b} = 2\hat{i} + 3\hat{j} + 6\hat{k}$. The length of the perpendicular drawn from a point P with position vector $= \hat{i} + 2\hat{j} + 3\hat{k}$ to L_1 is

Options:

A. 0

B. $\sqrt{15}$

C. $2\sqrt{3}$

D. $\sqrt{10}$

Question 57

If the distance between the foci is equal to the length of the latus rectum, then the eccentricity of the ellipse is

Options:

A. $\frac{\sqrt{5}+1}{2}$

B. $\frac{1-\sqrt{5}}{2}$

C. $\frac{\sqrt{5}-1}{2}$

D. $\frac{1\pm\sqrt{5}}{2}$

Question 58

In an entrance test, there are multiple choice questions. There are four possible answers to each question of which only one is correct. The probability that a student knows the answer to a question is 90%. If he gets the correct answer to a question, then the probability that he was guessing is

Options:

A. $\frac{36}{37}$

B. $\frac{1}{9}$

C. $\frac{1}{37}$

D. $\frac{37}{40}$

Question 59

The magnitude of the projection of the vector $-\hat{i}+2\hat{j}-\hat{k}$ on the z - axis is

Options:

A. 2

B. $\frac{1}{\sqrt{6}}$

C. 1

D. $-\frac{1}{\sqrt{6}}$

Question 60

A solid S is made from a cylinder surmounted by a hemisphere on top with both its circular faces sharing a common centre. The radius of cylinder and radius of hemisphere are x cm. The height of the cylinder is $(20 - 4x)$cm and the volume of S is $V = \frac{1}{3}\pi y$. Find the maximum value of y.

Options:

A. 480

B. 360

C. 320

D. 160

Question 1

What volume of $0.2MCH_3COOH$ needs to be added to 100 ml of $0.4MCH_3COONa$ solution to prepare a buffer of pH equal to 4.91 ? (pK_a of CH_3COOH is 4.76)

Options:

A. 282.6 ml

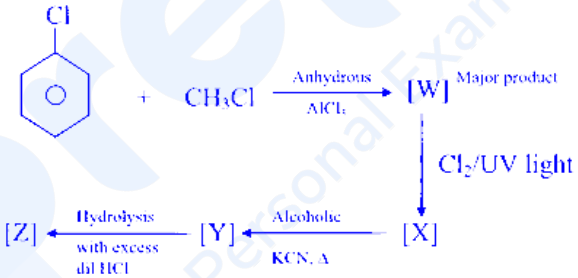
B. 213.65 ml

C. 101.41 ml

D. 141.54 ml

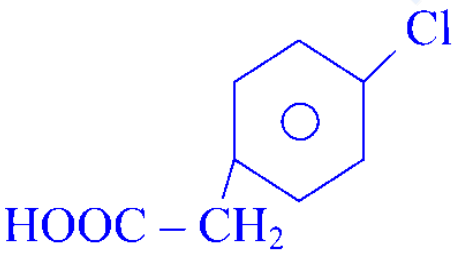
Question 2

Identify the final product $[Z]$ formed when Chlorobenzene undergoes the given series of reactions:

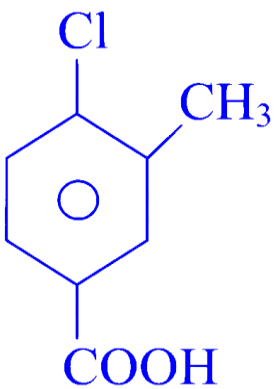


Options:

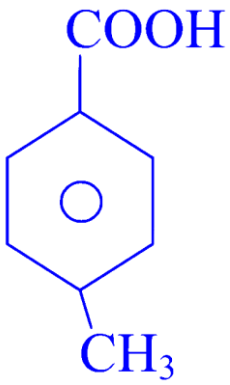
A.



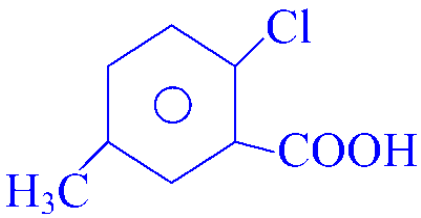
B.



C.



D.



Question 3

Two volatile liquids X and Y form an ideal solution at 298 K and have vapour pressures equal to 100 mm and 200 mm of Hg respectively in their pure state. The mole fraction of X in the solution is 0.4 and the mole fraction of Y in the vapour phase is $a/20$. Calculate the value of a.

Options:

A. 25

B. 15

C. 10

D. 5

Question 4

0.4 g of Propane burns completely at 300 K in a bomb calorimeter. The temperature of the calorimeter and surrounding water rises by 0.4^0C. If the heat capacity of the calorimeter and contents is $24\ kJ\ K^{-1}$ what is the Enthalpy for the reaction? (Assume that propane gas shows ideal behaviour).

Options:

A. −1006.9 kJ

B. −1063.5 kJ

C. −2084.6 kJ

D. −1902.8 kJ

Question 5

Match the metals in Column II with their characteristic properties given in Column I.

	Properties		Metals
A.	Lanthanoid with low value of 3^{rd} ionisation enthalpy.	P	V
B.	f-Block element with electronic configuration $[Rn]\ 6d^2 7s^2$	Q	Gd
C.	3 d -series metal whose $M^{3+}_{(aq)}$ is colourless.	R	Th
D.	3d-series metal with highest $\Delta H_{(atomisation)}$	S	Sc

Options:

A. A = Q B = R C = S D = P

B. A = R B = Q C = S D = P

C. A = R B = Q C = P D = S

D. A = S B = R C = Q D = P

Question 6

Convert Benzene → 3-Bromophenol by choosing appropriate reagents [(i) to (v)] in the correct sequence.

(i) $NaNO_2/HCl\ (0°C)$

(ii) Conc. HNO_3/H_2SO_4

(iii) $H_2O/283\ K$

(iv) Fe/HCl

(v) $Br2/Fe$

Options:

A. v, ii, iii, i, iv

B. ii, v, iv, i, iii

C. iii, iv, v, ii, i

D. v, ii, i, iv, iii

Question 7

Choose the correct statement.

Options:

A. Calcium and Magnesium metals are manufactured by electrolysis of aqueous solutions of their salts

B. The oxo-anion ClO_3^- does not undergo disproportionation reaction

C. Nitride ion N^{-3} cannot act as an oxidising agent

D. In alkaline medium the reduction of MnO_4^- ion involves gain of 5 electrons

Question 8

An aqueous solution of $CrCl_3.6H_2O$ (Molar mass = $266.5\ g/mol$) containing 2.665 g of the solute after processing, when treated with excess of $AgNO_3$ gave 2.87 g of AgCl (Molar mass of $AgCl = 143.5\ g/mol$) Choose the correct formula of the compound which give these results.

Options:

A. $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$

B. $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$

C. $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$

D. $[Cr(H_2O)_6]Cl_3$

Question 9

In which one of the following pairs does the stability of the monovalent ion increase with respect to the molecule, while the magnetic character remains the same for both?

Options:

A. C_2/C_2^+

B. O_2/O_2^+

C. B_2/B_2^+

D. N_2/N_2^+

Question 10

When 9.2×10^{-3} kg of formic acid is added to 600 ml of water the freezing point of water is depressed. If 30% of Formic acid undergoes dissociation what would be the freezing point of the solution? (K_f of H_2O is 1.86 K kg mol ; MM of formic acid: 46 amu)

Options:

A. 273.9 K

B. 272.2 K

C. 270.1 K

D. 270.8 K

Question 11

An organic compound [X] (molecular formula- $C_5H_{11}NO$ when reacted with Br_2 / aq. NaOH yielded [Y] which reacts with $CHCl_3$ and Ethanolic KOH to produce a foul smelling compound. Compound [Y] also reacts with HONO to produce Butan-1-ol with liberation of N_2(g). Identify [X].

Options:

A. $CH_3 - (CH_2)_3 - CONH_2$

B. $CH_3 - (CH)_2 - CO - CH_2 - NH_2$

C. $CH - CH_2 - CO - (CH_2)_2 - NH$

D. $CH_3 - (CH_2)_2 - CH(NH_2) - CHO$

Question 12

Choose the correct statement.

Options:

A. Ionic compounds of Sc^{3+} and $Cu^{+}$are coloured because of $d - d$ electronic transitions

B. The order in which the paramagnetic nature of the 4 cations Cr^{2+}, Mn^{2+}, V^{2+} and Fe^{2+} vary is $V^{2+} < Cr^{2+} = Mn^{2+} < Fe^{2+}$

C. As the oxidation number of the transition element increases, the ionic nature decreases and the oxides show acidic nature predominantly

D. The metal Cobalt has the electronic configuration $[Ar]\,3\,d^5$ in the +3 oxidation state

Question 13

Two statements, One Assertion (A) and the other Reason (R) are given. Choose the right option.

Assertion: The rate constant (k) for a chemical reaction gets nearly doubled for a 10^0 rise in temperature.

Reason: The number of bimolecular collisions between reactant molecules increase with increase in temperature

Options:

A. A is correct but R is wrong.

B. Both A and R are correct but R is not the correct explanation of A .

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

D. A is wrong but R is correct.

Question 14

Which one of the following is a true statement with reference to reaction between 2- Bromo-2-methylpropane and aqueous KOH ?

Options:

A. The rate of reaction depends on the concentration of the haloalkane and the nucleophile OH^-

B. The reaction occurs at a fast rate since the substrate is a tertiary alkyl halide and follows S_N1 mechanism.

C. The reaction is not favoured by the presence of polar protic solvent.

D. The reaction occurs at a slow rate since it follows S_N2 mechanism.

Question 15

Which of the following haloalkanes will give more than one isomeric product, on being heated with alc. KOH ?

Options:

A. 1- Chloro-2-methylbutane

B. 1-Chloropentane.

C. 2-Chloro-3, 3-dimethylpentane

D. 2- Chlorobutane.

Question 16

Which one of the following coordination compounds will exhibit both geometrical and optical isomerism?

Options:

A. $[Cr(ox)_3]^{3-}$

B. $[Co(en)_2Cl_2]^{+}$

C. $[Co(CN)6]^{3-}$

D. $[Co(NO_3)_3(NH_3)_3]$

Question 17

The concentration and percentage purity of Oxalic acid can be determined by titration with $KMnO_4$ in presence of dil. H_2SO_4. Instead of dil. H_2SO_4, dil HCl cannot be used because

Options:

A. HCl can also reduce MnO_4^- **to** Mn^{2+}

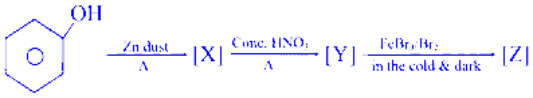
B. HCl can also provide H^+ **ions in addition to** H^+ **ions from Oxalic acid.**

C. HCl can also oxidise Oxalic acid to CO_2 **and** H_2O**.**

D. Oxalic acid oxidises HCl to Cl_2**.**

Question 18

What is the final product [Z] formed when the given reactions take place?



Options:

A. 4-Bromonitrobenzene.

B. 2-Bromonitrobenzene.

C. 2, 4, 6-tribromonitrobenzene.

D. 3-Bromonitrobenzene.

Question 19

A non-volatile solute A weighing 60 g when dissolved in 212 g of the solvent Xylene reduces its vapour pressure to 60%. What is the Molar mass of A in g/mol ? [MM of xylene = 106 g/mol]

Options:

A. 56

B. 126

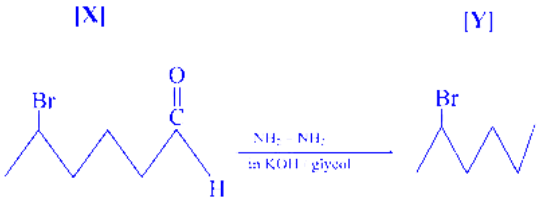
C. 60

D. 45

Question 20

Two statements, one Assertion (A) and the other Reason (R) are given. Choose the correct option.

Assertion: Compound [X] reacts with Hydrazine in presence of KOH/ Glycol to form the product [Y].



Reason: Reduction reaction occurs and Carbonyl group is reduced to Methylene group.

Options:

A. Both A and R are correct but R is not the correct explanation of A .

B. Both A and R are correct and R is the correct explanation of A .

C. A is wrong but R is correct.

D. A is correct but R is wrong.

Question 21

For a 1.0 molal solution containing the non-volatile solute Urea, the elevation in boiling point is 2.0 K while the depression in freezing point in a 3.0 molal solution having the same solvent is $4.0K$. If the ratio $\frac{K_b}{K_f} = \frac{1}{X}$, what is the value of X ?

Options:

A. $\frac{1}{2}$

B. $\frac{1}{4}$

C. $\frac{2}{3}$

D. $\frac{3}{2}$

Question 22

Identify the correct statement.

Options:

A. The central atoms in both CH_4 and SF_4 are in a state of sp^3 hybridisation

B. The resultant dipole moment of NF_3 is greater than that of NH_3

C. The $C-O$ bond length in CO_2 molecule is 110 pm because of the Inductive effect $(+I)$ of oxygen

D. A molecule of the type AB_5E where the central atom has 5 bond pairs and 1 lone pair has a square pyramid g eometry

Question 23

Choose the incorrect statement.

Options:

A. The hormone Glucocorticoid controls the level of excretion of water and salts by the kidney.

B. Vitamins *A* and *K* are fat soluble and are stored in the liver of human beings.

C. Denaturation of protein is due to loss of both the secondary and tertiary structures of the protein.

D. Complete hydrolysis of RNA gives Nitrogen containing bases, a pentose sugar and phosphoric acid.

Question 24

Solubility product of the sparingly soluble salt $AgBrO_3$ in aqueous medium is 9.3×10^{-10} Calculate the mass in gram of $AgBrO_3$ present in 100 ml of its saturated solution. (Molar mass of $AgBrO_3$ is $236\ g/mol$)

Options:

A. 3.0495×10^{-4}

B. 4.962×10^{-4}

C. 6.248×10^{-5}

D. 7.198×10^{-4}

Question 25

What is the reduction potential of a half-cell consisting of a Pt electrode dipped in $2.2 M Fe^{2+}$ and $0.04 M Fe^{3+}$ solution where the reaction taking place is conversion of Fe^{3+} ions to Fe^{2+} ?

$$E^0 \left(Fe^{3+}/Fe^{2+}\right) = 0.771 \text{ V}$$

Options:

A. 0.598 V

B. 0.723 V

C. 0.668 V

D. 0.719 V

Question 26

Both reactions (i) and (ii) give the same compound X as the major product. Identify X

(i). 3-Methylbut-1-ene $+HCl \rightarrow X$

(ii). Neopentyl alcohol $+HCl$ (**anh.** $ZnCl_2) \rightarrow X$

Options:

A. $(CH_3)_2 - CH - CHCl - CH_3$

B. $(CH\ )_2 - CCl - CH_2 - CH_3$

C. $CH_3 - CH_2 - CH(CH_3) - CH_2Cl$

D. $(CH_3)_2 - CH - CH_2 - CH_2Cl$

Question 27

Two chemical reactions of the same order have equal Frequency factor value. Their Activation energies differ by $26.8\ kJ/mol$**. At 300 K if** $k_2 = xk_1$ **find the value of** x**.**

Options:

A. 4.631×10^4

B. 1.143×10^3

C. 2.286×10^3

D. 4.665

Question 28

Arrange the following compounds in the decreasing order of the molar conductivities of their aqueous solutions.

A	B	C	D
$[Co(NH_3)_5Cl]Cl_2$	$[Co(NH_3)_3Cl_3]$	$[Co(NH_3)_4Cl_2]Cl$	$[Co(NH_3)_6]Cl_3$

Options:

A. B > C > A > D

B. D > A > C > B

C. B > A > C > D

D. A > B > D > C

Question 29

From the given covalent compounds (A to F) identify the pair of molecules which have:

(i) Two lone pairs of electrons on the central atom.

(ii) One lone pair of electrons on the central atom.

A. SO_2
B. ClF_3
C. BF_3
D. BrF_5
E. XeF_4
F. SF_6

Options:

A. (i) *A&F* **(ii)** *A&E*

B.(i) *D&F* **(ii)** C&D

C. (i) *B* **&** *E* **(ii)** A&D

D. (i) C& A **(ii)** B&C

Question 30

A current of 2.5 amperes is passed through 800 ml of 0.48 M solution of $CuSO_4$ for 1.0 hour with a current efficiency of 80%. If the volume of the solution remains unchanged, what is the final molarity of the solution?

Options:

A. 0.386

B. 0.315

C. 0.433

D. 0.298

Question 31

A certain orbital having 2 angular nodes and no radial nodes is:

Options:

A. 3d

B. 3sC

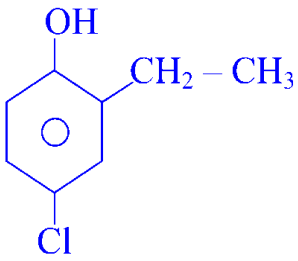
. 3pD.

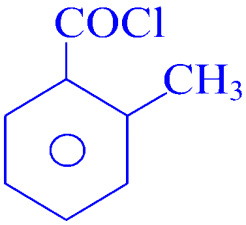
2p

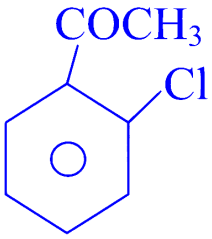
Question 32

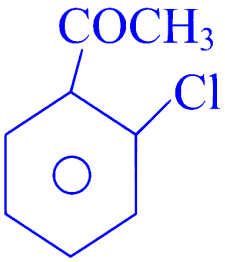
An organic compound [X] reacts with $H_2/Pd - BaSO_4$ to give compound [Y] which reduces Tollen's reagent and undergoes Cannizzaro's reaction. On rigorous oxidation of [Y] in presence of $KMnO_4/H^+$Phthalic acid is the product obtained. What is [X] ?

Options:

A. 

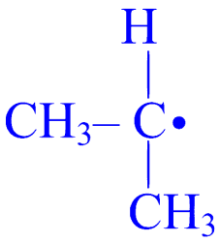
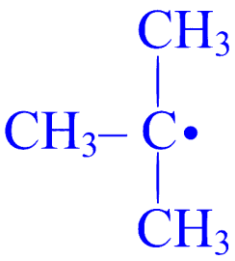
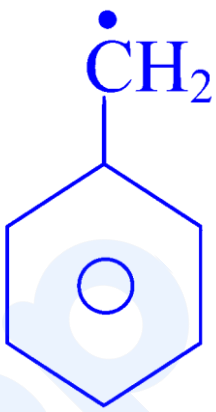
B. 

C. 

D. 

Question 33

Arrange the following free radicals in the increasing order of their stability:

A	B	C	D
			

Options:

A. A < B < D < C

B. C < D < B < A

C. C < B < D < A

D. A < B < C < D

Question 34

If X is a haloalkane with a single Chlorine atom per molecule and the percentage of Cl is 55 , what would be the number of Cl atoms present in 0.1 g of the haloalkane? Atomic mass of Cl = 35.5 g/mol

Options:

A. 6.022×10^{22}

B. 1.2044×10^{21}

C. 9.328×10^{20}

D. 9.329×10^{23}

Question 35

For a reaction $X_2(l) + Y_2(g) \rightleftharpoons 2XY(g)$, the ΔH^0 and ΔS^0 are $+29.3\ kJ/mol$ and $104.1\ J\ K^{-1}\ mol^{-1}$ respectively at 298 K . Find the free energy change in kJ/mol.

Options:

A. 0.6

B. 2.04

C. 5.2

D. 1.72

Question 36

Which one of the following reactions does not give the correct combination of reactants and the major products formed in the reaction?

Options:

A. $CH_3 - CO - CH_3 + NH_2 - NH - CO - NH_2$ (**weakly basic**) $\rightarrow (CH_3)_2C = N - NH - CO - NH_2$

B. $CH_3CHO + 2C_2H_5OH$ (**dry HCl gas**) $\rightleftharpoons CH_3 - CH - (OC_2H_5)_2$

C. $CH_3 - CH = CH - CH_2 - CH_2 - CN \xrightarrow[\text{(ii). } H_2O]{\text{(i). DIBAL-H}} CH_3 - (CH_2)_4 - CHO$

D. $C_6H_5 - CO - CH_3 + I_2 + Na_2CO_3$ (**Heat**) $\rightarrow CHI_3 + C_6H_5COO^{--}$

Question 37

Match the coordination compounds in Column I having the given type of hybridisation of M^{n+} ion and magnetic moment as given in Column II.

	Coordination compounds		Hybridisation & Magnetic nature
A.	$Ni(CO)_4$	P.	sp^3, $\mu = 5.92BM$
B.	$[Ni(CN)_4]^{2-}$	Q.	sp^3, $\mu = 2.84BM$
C.	$[Ni(Cl)_4]^{2-}$	R.	sp^3, $\mu = 0$
D.	$[MnBr_4]^{2-}$	S.	dsp^2, $\mu = 0$

Options:

A. A = R B = S C = Q D = P

B. *A = S B = R C = P D = Q*

C. A = S B = P C = R D = Q

D. A = Q B = P C = S D = R

Question 38

The EMF of the cell $Al/Al^{3+}(0.01M)\|Fe^{2+}(0.02M)/Fe$ is 1.209 V . The EMF of the cell can be increased by

Options:

A. increasing the concentration of Al^{3+} **and** Fe^{2+}

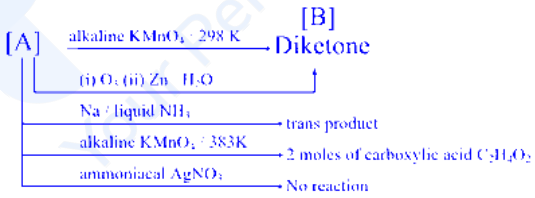
B. increasing the concentration of Al^{3+}

C. increasing the concentration of Fe^{2+}

D. decreasing the concentration of Al^{3+} **and** Fe^{2+}

Question 39

An unsaturated hydrocarbon [A] undergoes the following series of reactions. Identify [A].



Options:

A.Propyne

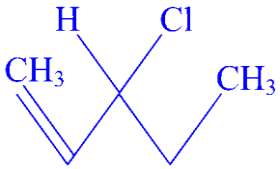
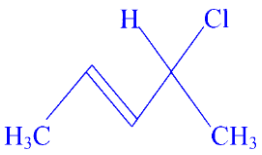
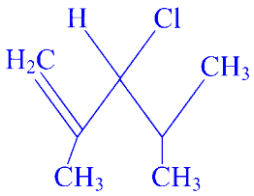
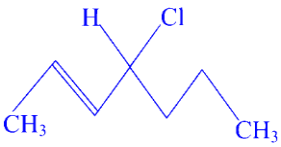
B.But-2-yne

C.But-1-yne

D.But-2-ene

Question 40

Identify the compound which haloalkane on reaction with

A	B	C	D
			

Options:

A.A

B. B

C. D

D. C

Question 41

For a given reaction of the type $\frac{3}{5}X(aq) \rightarrow \frac{1}{2}Y(aq) + Z(g)$, the correct expression for the rate of disappearance of X with reference to Y is _____

Options:

A. $-d\frac{[X]}{dt} = +\frac{6}{5}d\frac{[Y]}{dt}$

B. $-d\frac{[X]}{dt} = +\frac{5}{6}d\frac{[Y]}{dt}$

C. $-d\frac{[X]}{dt} = +\frac{3}{10}d\frac{[Y]}{dt}$

D. $-d\frac{[X]}{dt} = d\frac{[Y]^{1/2}}{dt}$

Question 42

Which one of the following statements is correct?

Options:

A. The major product formed when 2- Methylpropene reacts with dilute H_2SO_4 is tert. butyl alcohol.

B. The Electrophilic addition to an unsymmetrical alkene always occurs through the formation of a more stable Carbanion intermediate.

C. Between the two alkenes - (i) $(CH_3)_2 - C = CH - CH_3$ and (ii). $C_6H_5 - CH = CH - CH_2 - CH_3$, compound (i) will show geometrical isomerism

D. Greater the number of alkyl groups attached to the double bonded Carbon atoms, the less stable is the alkene.

Question 43

Given that the standard enthalpy of combustion of $C_{(S)}$ and $CS_2(l)$ are -393.3 and $-1108.76\ kJ/mol$ respectively and the standard enthalpy of formation of CS_2 is $128.02\ kJ/mol$. What is ΔH^0_f of SO_2 ?

Options:

A. $-510.6\ kJ/mol$

B. $-293.72\ kJ/mol$

C. $-321.2\ kJ/mol$

D. $-587\ kJ/mol$

Question 44

Choose the correct statement.

Options:

A. A solution formed by adding Carbon di-sulphide to Acetone forms a maximum boiling azeotrope.

B. Hypotonic solution is more concentrated with respect to the other solution separated by a semi permeable membrane

C. For a solvent, $K_b = \frac{R \times M_1 \times T_b^2}{1000 \times \Delta \text{ Hvap}}$ **(R = Gas constant, M_1 = Molar mass of solvent, $T_b = B \cdot P$ of the solvent)**

D. A 1.0 molal solution of Glucose in water is more concentrated than 1.0 M glucose solution in the same solvent.

Question 45

Benzene diazonium chloride when warmed with water gives a compound, whose Sodium salt when reacted with Allyl bromide gives compound [X]. Identify [X].

Options:

A. $C_6H_5 - CH - (CH_3)_2$

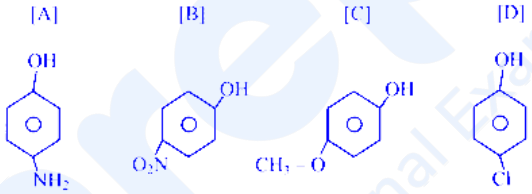
B. $C_6H_5 - O - CH_2 - CH = CH_2$

C. $C_6H_5 - O - CH_2 - CH_2 - CH_3$

D. $C_6H_5 - CH_2 - CH_2 - CH_3$

Question 46

Arrange the following in the decreasing order of their pK_a values.



Options:

A. A > C > D > B

B. C > A > B > D

C. B > D > C > A

D. D > C > A > B

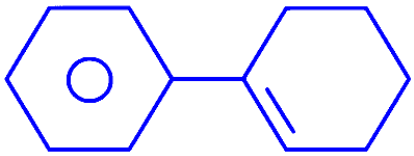
Question 47

Cyclohexanol undergoes a series of reactions as given. Identify compound (iv).

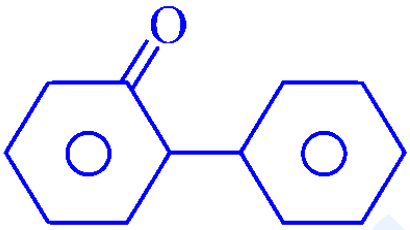
$C_6H_{11}OH + CrO_3 \rightarrow (i) + C_6H_5MgI \rightarrow (ii)+$ **dil.** $HCl \rightarrow (iii)+$ **Conc.** $H_3PO_4 \rightarrow (iv)$

Options:

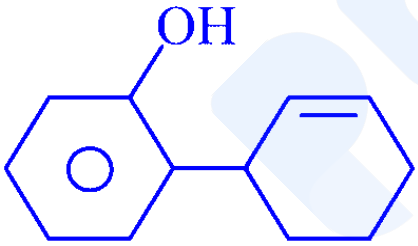
A.



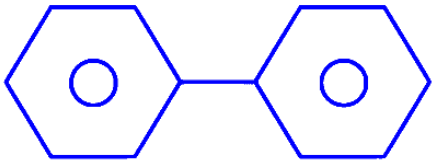
B.



C.

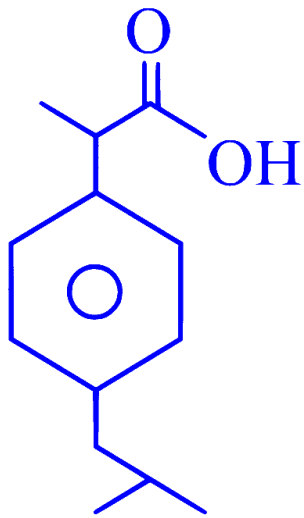
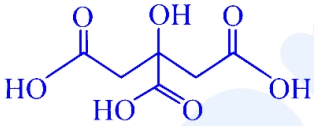
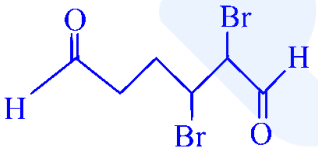
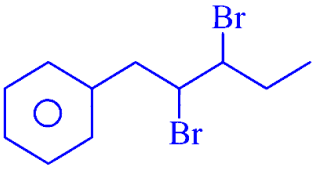


D.



Question 48

Match the structures in Column I with their correct IUPAC names given in Column II.

	Column I		Column II
A.		P.	2,3-Dibromo-1-phenylpentane.
B.		Q.	2,3- Dibromohexanedial.
C.		R.	2- (4- isobutylphenyl) propanoic acid
D.		S.	2- Hydroxy-1,2,3- propanetricarboxylic acid.

Options:

A. A = Q B = P C = S D = R

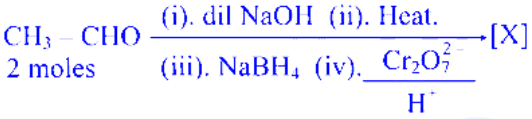
B. A = R B = S C = Q D = P

C. A = S B = R C = Q D = P

D. A = S B = R C = P D = Q

Question 49

Identify [X], the final product formed when 2 moles of Ethanal undergoes the following series of reactions with reagents [(i) to (iv)]



Options:

A. But-3-enoic acid

B. But-2-enoic acid

C. Propanoic acid

D. Ethanoic acid

Question 50

Two statements, one Assertion (A) and the other Reason (R) are given. Choose the correct option.

Assertion: Maltose, a disaccharide, is a reducing sugar and is obtained by the partial hydrolysis of starch in presence of the enzyme diastase.

Reason: Hydrolysis of one mole of Maltose gives one mole each of $\alpha - D-$ Glucose and $\beta - D-$ Fructose.

Options:

A. A is wrong but R is correct.

B. Both A and R are correct but R is not the correct explanation of A .

C. A is correct but R is wrong.

D. Both A and R are correct and R is the correct explanation of A .

Question 51

Which one of the following options represents the decreasing order of oxidation number of the central atom in:

$Cr_2O_7^{2-}$, CrO_2^-, MnO_4^-, BrO_3^-

Options:

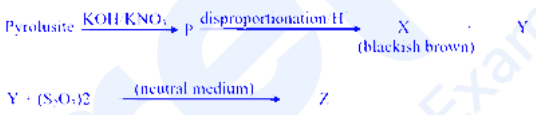
A. $CrO_2^- > BrO_3^- > Cr_2O_7^{2-} > MnO_4^-$

B. $MnO_4^- > CrO_2^- > Cr_2O_7^{2-} > BrO_3^-$

C. $BrO_3^- > CrO_2^- > MnO_4^- > Cr_2O_7^{2-}$

D. $MnO_4^- > Cr_2O_7^{2-} > BrO_3^- > CrO_2^-$

Question 52



What is the spin only magnetic moment of the metal ion in P and the oxidation number of Sulphur in the oxidised product Z ?

Options:

A.

$\mu = 0$ **Oxidation number** = +4

B.

$\mu = 5.00BM$ **Oxidation number** = 0

C.

$\mu = 5.92BM$ **Oxidation number** = +2

D.

$\mu = 1.732BM$ **Oxidation number** = +6

Question 53

The conductivity of 0.01 M solution of CH_3COOH at 298 K is $1.65 \times 10^{-4} Scm^{-1}$ What is the pK_a value of the acid if $\lambda^0 (H^+)$and $\lambda^0 (CH_3COO)^{-1}$ are $349.1 Scm^2\ mol^{-1}$ and $40.9 Scm^2\ mol^{-1}$ respectively?

Options:

A. 4.73

B. 1.87

C. 3.47

D. 2.95

Question 54

Two statements, one Assertion (A) and the other Reason (R) are given. Choose the correct option.

Assertion: 2-aminoethanoic acid and p-aminobenzene sulphonic acid can exist as Zwitter ions while p-aminobenzoic acid cannot.

Reason: When the acid group is a relatively strong proton donor and the $-NH_2$ group is sufficiently basic it can accept a H^+ion from the acid group to form the dipolar ion.

Options:

A. Both A and R are correct and R is the correct explanation of A .

B. A is correct but R is wrong.

C. A is wrong but R is correct.

D. Both A and R are correct but R is not the correct explanation of A .

Question 55

$X \rightarrow 2Y$ is a first order reaction where $1.0\ mol/L$ of the reactant yields $0.4\ mol/L$ of Y in 200 minutes. Calculate the half-life period of the reaction in minutes.

Options:

A. 151.24

B. 203.69

C. 620.96

D. 271.34

Question 56

Match the reactions of Glucose given in Column I with the major product formed in the reaction as in Column II.

	Column I - Reactions		Column II - Major product
A.	$C_6H_{12}O_6$ + HI (Heat)	P.	$HOOC-(CHOH)_4-COOH$
B.	$C_6H_{12}O_6$ + $Br_2(aq)$	Q.	$CH_3-(CH_2)_4-CH_3$
C.	$C_6H_{12}O_6$+ Conc. HNO_3	R.	$NH_4O-OC-(CHOH)_4-CH_2OH$
D.	$C_6H_{12}O_6$ + 2 $[Ag(NH_3)_2]OH$	S.	$HOOC-(CHOH)_4-CH_2OH$

Options:

A. A = S B = R C = Q D = P

B. *A = P B = S C = Q D = R*

C. A = R B = P C = S D = Q

D. A = Q B = S C = P D = R

Question 57

A certain gas absorbs photon of wavelength 4.0×10^{-7} m and emits radiation at two wavelengths. If one of the emissions occurs at 7.5×10^{-7} m, what is the wavelength at which the second emission occurs?

Options:

A. 650 nm

B. 857 nm

C. 700 nm

D. 680 nm

Question 58

The following results were obtained during study of the reaction $2NO(g) + Cl_2(g) \rightarrow 2NOCl(g)$. Determine the value of $[X]$ in mol/L

Experiment	[NO] mol / L	[Cl_2] mol / L	Initial rate of formation. [NOCl] mol / L / min
I	0.2	0.2	6.0×10^{-3}
II	0.2	0.4	2.4×10^{-2}
III	0.4	0.2	1.2×10^{-2}
IV	X	0.6	1.35×10^{-1}

Options:

A. $[X] = 0.8$

B. $[X] = 0.3$

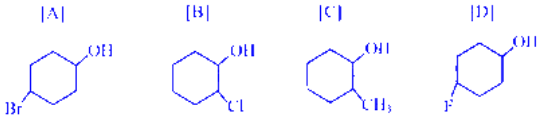
C. $[X] = 0.4$

D. $[X] = 0.5$

Question 59

Two statements, One Assertion [A] and the other Reason [R] are given. Identify the correct option

Assertion $[A]$: The decreasing order of the acidic character of the following is $B > D > A > C$



Reason $[R]$: Fluorine has larger -I effect than Cl and Br .

Options:

A.

A is correct but R is wrong.

B.

Both A and R are correct and R is the correct explanation of A .

C.

A is wrong but R is correct.

D.

Both A and R are correct but R is not the correct explanation of A .

Physics

Question 1

According to Bohr's theory of hydrogen atom, the speed of the electron, its energy and radius of its orbit vary with the principal quantum number n, respectively as

Options:

A. $\frac{1}{n}, n^2, \frac{1}{n^2}$

B. $\frac{1}{n}, \frac{1}{n^2}, n^2$

C. $n, \frac{1}{n^2}, n^2$

D. $\frac{1}{n^2}, \frac{1}{n}, n^2$

Question 2

A particle of mass M at rest decays into masses m_1 and m_2 with non-zero velocities. The ratio of de Broglie wavelengths λ_1 and λ_2 of the particles is

Options:

A. $\frac{m_2}{m_1}$

B. $\frac{\sqrt{m_1}}{\sqrt{m_2}}$

C. $\frac{m_1}{m_2}$

D. $1:1$

Question 3

The nuclear forces

a. are central forces, independent of the spin of the nucleons.

b. have a short-range dominant over a distance of about a few fermi

c. are stronger being hundred times stronger than that of electromagnetic forces.

d. are independent of the nuclear charge.

Which of the above is not true?

Options:

A. c

B. a

C. b

D. d

Question 4

Two light rays A and B travel from a medium into air at angles of incidence 15 degrees and 42 degrees respectively. In the medium, light travels 3 cm in 0.2 ns . Will there be total internal reflection? If so, which ray?

Options:

A. No

B. Yes, A

C. Yes, B

D. Yes, Both A and B

Question 5

An electric field $E = 3x^2 iNC^{-1}$ exists in a certain region of space. The potential difference between the origin and at $x = 4m$, $V_0 - V_4$ is

Options:

A. −20 V

B. −40 V

C. −64 V

D. 64 V

Question 6

A current loop consists of two identical semicircular parts each of radius $2R$, one lying in the $x-y$ plane and the other in $x-z$ plane. If the current in the loop is I, the resultant magnetic field due to two semicircular parts at their common centre is

Options:

A. $\frac{\mu_o I}{4R}$

B. $\frac{4\mu_o I}{\sqrt{2}R}$

C. $\frac{\mu_o I}{\sqrt{2}R}$

D. $\frac{\mu_o I}{4\sqrt{2}R}$

Question 7

Which of the following is not a characteristic of diamagnetism?

Options:

A. The material moves from a region of strong magnetic field to weak magnetic field.

B. The origin of diamagnetism is the spin of electrons.

C. Their magnetic susceptibility is small and negative.

D. Diamagnetic materials are repelled by bar magnets.

Question 8

An ideal inductor is connected across a capacitor. Oscillations of energy K are set up in the circuit. The capacitor plates are slowly drawn apart such that the frequency of oscillations is quadrupled. The work done in the process is

Options:

A. 15K

B. 13K

C. zero

D. 2K

Question 9

A symmetric double convex lens is cut into two equal parts by a plane perpendicular to the principal axis. If the power of the original lens is 4D, the difference between the powers of the original lens and the cut lens is

Options:

A. zero

B. 3D

C. D

D. 2D

Question 10

Three identical conducting balls A, B and C , each of mass m , are thrown upward at an angle Θ to the horizontal with an initial speed v in a region of space that has a uniform electric field E downward along with the gravitational field g. A is positively charged, B is uncharged and C is negatively charged. Rank the ranges R of these three balls in increasing order.

Options:

A. $R_A < R_B < R_C$

B. $R_B < R_C < R_A$

C. $R_A = R_B < R_C$

D. $R_C < R_B < R_A$

Question 11

In a single slit Fraunhofer diffraction pattern obtained at normal incidence, at the angular position of the second diffraction minimum the phase difference (in radian) between the waves from the opposite edges of the slit is

Options:

A. π

B. **zero**

C. 2π

D. $\frac{\pi}{2}$

Question 12

The magnetic flux ϕ through a stationary loop of wire having a resistance R varies with time as $\phi = 4t^2 + 3t$. The

average emf and total charge flowing in the loop in the time interval $t = 0$ to $t = \tau$ respectively are

Options:

A. $\tau + 3$,**B** $\frac{4\tau^2+3\tau}{R}$

. $3\tau + 4$,**C.** $\frac{4\tau^2+3\tau}{R}$

$4\tau + 3$,**D.** $\frac{4\tau+3}{R}$

$4\tau + 3$, $\frac{4\tau^2+3\tau}{R}$

Question 13

A stone is dropped from a height h. It hits the ground with a certain momentum ' p '. If the same stone is dropped from a different height h ' such that percentage change in

momentum is 41.4%, then the height from which the stone is dropped is $h' = x\ h$, where x is:

Options:

A. 4

B. 2

C. 6

D. 3

Question 14

Point charges $-3Q$, $-q$, $2q$ and $2Q$ are placed, one at each corner of a square. The relation between Q and q for which the potential at the centre of the square is zero is

Options:

A. $Q = \frac{1}{q}$

B. $Q = -q$

C. $Q = \frac{-1}{q}$

D. $Q = q$

Question 15

If R and L denote resistance and inductance of a material, then the dimension of LR will be:

Options:

A. $M^2L^4T^{-5}A^{-4}$

B. $MLTA^{-1}$

C. $M^0L^0T^0A^0$

D. $M^{-1}L^4TA^{-3}$

Question 16

A student measures the terminal potential difference V of a cell (emf ε and internal resistance r) as a function of current I flowing through it, and draws V versus I graph. The slope and intercept of the graph respectively are

Options:

A. $-r, -\varepsilon$

B. $-r, \varepsilon$

C. $r, -\varepsilon$

D. r, ε

Question 17

A galvanometer of resistance 50Ω is connected to a battery of 4 V along with a resistance of 3950Ω in series. A full-scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 10 divisions, the resistance in series should be equal to:

Options:

A. 8950 ohm

B. 11950 ohm

C. 7000 ohm

D. 6000 ohm

Question 18

Two capacitors C_1 and C_2 are charged to 100 V and 120 V respectively. It is found that upon connecting them together in parallel, the potential on each one of them is zero. Therefore

Options:

A. $C_1 + 3C_2 = 0$

B. $5C_{11} = 3C_{22}$

C. $5C + 6C = 0$

D. $5C_1 = 6C_2$

Question 19

Two very long, straight, parallel wires carry steady currents I and 21 respectively. The distance between the wires is d . At a certain instant of time, a point charge q is at a point equidistant from the two wires, in the plane of the wires. Its instantaneous velocity is v perpendicular to this plane. The magnitude of the force due to the magnetic field acting on the charge at this instant is

Options:

A. $\frac{\mu_o I q v}{\pi d}$

B. zero

C. $\frac{2\mu_o I q v}{\pi d}$

D. $\frac{\mu_o I q v}{2\pi d}$

Question 20

A bulb of resistance 280 Ohm is supplied with a voltage $V = 400 \sin \pi t$**. The peak current is**

Options:

A. 2.22 A

B. 2.02 A

C. 1.11 A

D. 1.43 A

Question 21

A wooden block floats with $\frac{3}{5}$ **of its volume submerged in a tank of water. If a denser liquid is poured into the tank, the wooden block floats with half its volume in the liquid and the remaining half in water. The relative density of the liquid is:**

Options:

A. $\frac{1}{2}$

B. $\frac{1}{3}$

C. $\frac{1}{6}$

D. $\frac{1}{5}$

Question 22

A particle starts from rest and moves along the x -axis with a velocity that varies as $v = \sqrt{100 + 4x}\ ms^{-1}$. The acceleration of the particle is:

Options:

A. $25\ ms^{-2}$

B. $5\ ms^{-2}$

C. $4\ ms^{-2}$

D. $2\ ms^{-2}$

Question 23

One surface of a lens is convex and the other is concave. If the radii of curvatures are R and r respectively, the lens will be convex if

Options:

A. $R > r$

B. $R < r$

C. $R = \frac{1}{r}$

D. $R = \underline{r}$

Question 24

Emission of electrons from a metal plate illuminated with monochromatic electromagnetic radiation will always take place provided

Options:

A. The plate is positively charged

B. The plate is negatively charged

C. The radiation is sufficiently intense

D. The work function of the plate is less than the energy of a single photon and the plate is uncharged

Question 25

A charged particle is released from rest in a region of space in which steady and uniform electric and magnetic fields are parallel to each other. The particle will move in a

Options:

A. Helix

B. Straight line

C. Cycloid

D. Circle

Question 26

If E is the amplitude of the electric field of the waves starting from the slits in a double slit experiment and θ is the phase difference between the waves reaching a point on the screen, the ratio of the amplitude of the resultant electric field at that point on the screen to the amplitude at one of the slits is

Options:

A. $\cos(\theta)$

B. $2\cos(\theta)$

C. $\cos\left(\frac{\theta}{2}\right)$

D. $2\cos\left(\frac{\theta}{2}\right)$

Question 27

Two coherent waves of intensities I_1 and I_2 pass through a region at the same time in the same direction. The sum of maximum to minimum intensities is

Options:

A. $(I_1 + I_2)$

B. $2\,(I_1 + I_2)$

C. $2(\sqrt{I} + \sqrt{I_2})^2$

D. $(I_1 + I_2)^2$

Question 28

A Si and a Ge diode has identical physical dimensions. The band gap in Si is larger than that in Ge. On applying identical reverse bias across these diodes,

Options:

A.

The reverse current in Ge is lesser than that in Si .

B.

The relative magnitudes of reverse currents cannot be determined from the given data.

C.

The reverse current is identical in both cases.

D.

The reverse current in Ge is larger than that in Si .

Question 29

A convex lens forms a real image of an object with magnification m_1. The lens is moved towards the object to obtain another real image of magnification m_2. The image distance is increased by x. The focal length of the lens is

Options:

A. $\left(\frac{m_2}{m_1}\right)x$

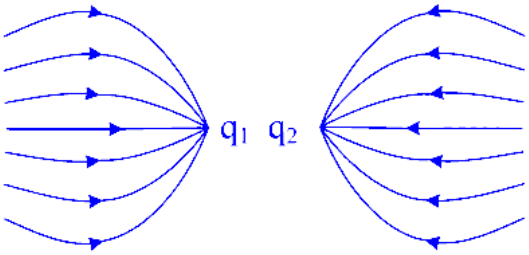
B. $\left(\frac{m_1}{m_2}\right)x$

C. $\frac{x}{m_2-m_1}$

D. $x\left(m_2-m_1\right)$

Question 30

For the charge configuration shown here, which of the following is not true?



Options:

A.

$\frac{q_1}{q_2} = 1$

B.

$|q_1| = |q_2|$

C.

$|q_1| > |q_2|$

D.

q_1 **and** q_2 **are negative**

Question 31

A bomb of mass 20 kg at rest explodes into two pieces of masses 12 kg and 8 kg . If the velocity of 8 kg mass is $6\ ms^{-1}$, then the kinetic energy of the other mass is:

Options:

A. 144 J

B. 64 J

C. 86 J

D. 96 J

Question32

Two identical conducting balls having positive charges q_1 and q_2 are separated by a distance r. If they are made to touch each other and then separated to the same distance, the force between them will be

Options:

A. Same as before

B. zero

C. Less than before

D. More than before

Question 33

Two simple harmonic motions are represented by equations $y_1 = 0.5 \sin[200\pi t + \frac{\pi}{3}]$ and $y_1 = 0.5 \cos \pi t$. The phase difference of the velocity of particle 1 with respect to the velocity of particle 2 is :

Options:

A. $\frac{\pi}{2}$

B. $\frac{\pi}{6}$

C. $\frac{-\pi}{6}$

D. $\frac{-\pi}{2}$

Question 34

Two identical conductors of lengths 1 and 31 respectively are maintained at the same temperature. They are given potential differences in the ratio $1:3$. The ratio of their drift velocities is

Options:

A. 1 : 9

B. 9 : 1

C. 1 : 1

D. 1 : 3

Question 35

If voltage across a bulb rated $220\ V, 50\ W$ drops by 5% of its rated value, the percentage of the rated value by which the power would decrease is

Options:

A. 10%

B. 2.5%

C. 15%

D. 5%

Question 36

A vertical spring of spring constant $24 Nm^{-1}$ is fixed on a table. A ball of mass 0.5 kg at a height 2 m above the free upper end of the spring falls vertically on the spring so that the spring is compressed by a distance of 50 cm . The net work done in the process is:

Options:

A. 6.5 J

B. 10.5 J

C. 12.5 J

D. 9.5 J

Question 37

The resistance of a wire is 5 ohm at $25^{\circ}C$ and 7 ohm at $100^{\circ}C$. The resistance of the wire at $0^{\circ}C$ is

Options:

A. $\frac{13}{3}$ ohm

B. $\frac{5}{3}$ ohm

C. $\frac{2}{3}$ **ohm**

D. 0.1 ohm

Question 38

A sonometer string vibrates with a frequency of 400 Hz . When the length of the string is halved and the tension is altered, it begins to vibrate with a frequency of 200 Hz . The ratio of the new tension to the original tension in the string is:

Options:

A. 4 : 1

B. 16 : 1

C. 1 : 4

D. 1 : 16

Question 39

In an experiment to measure the density of the material of a sphere, an error of 2% occurred while measuring the radius o f a sphere and an error of 3% occurred while measuring the m ass of the sphere. What is the maximum percentage error in the measurement of density?

Options:

A. 8

B. 6

C. 7

D. 9

Question 40

The radius of earth is R and acceleration due to gravity on its surface is g. The height at which the acceleration due to gravity becomes $\frac{g}{8}$ is:

Options:

A. $2R$

B. $(2\sqrt{2}-1)R$

C. $\sqrt{2}R$

D. $2\sqrt{2}R$

Question 41

A block of metal A is connected in series with another block of metal B such that the two metal blocks have the same area of cross sections. The thermal conductivity of metal A is K and the free end of metal A is at $80°C$. The temperature of the interface is $60°C$ and the free end of metal B is at $20°C$. Assuming the two metals have the same thickness, the conductivity of metal B is:

Options:

A. $2K$

B. $4K$

C. $\frac{K}{2}$

D. $\frac{K}{4}$

Question 42

The mean energy per molecule for a diatomic gas is:

Options:

A. $\left(\frac{5}{2}\right)K_BT$

B. $\left(\frac{3}{2}\right)K_BT$

C. $\left(\frac{3}{2N}\right)K_BT$

D. $\left(\frac{5}{2N}\right)K_BT$

Question 43

An LCR series ac circuit is at resonance with 10 V each across L, C and R . If the resistance is halved, the respective voltage across R, C and L are

Options:

A. 5 V, 10 V, 10 V

B. 10 V, 5 V, 5 V

C. 5 V, 5 V, 5 V

D. 10 V, 20 V, 20 V

Question 44

Which, of the following is true of the Balmer series of the hydrogen spectrum?

a. The series is in the visible region.

b. The entire series falls in the ultraviolet region

c. The entire series falls in the infrared region

d. The series is partly in the visible region and partly in the infrared region

Options:

A. b

B. c

C. a

D. d

Question 45

If the binding energy per nucleon in $_3Li^7$ and $_2He^4$ nuclei are respectively 5.60 MeV and 7.06 MeV , then energy of p in the reaction $p + {}_3Li^7 \rightarrow 2{}_2He^4$ is

Options:

A. 12.28 MeV

B. 13.28 MeV

C. 28.28 MeV

D. 17.28 MeV

Question 46

From a circular disc of radius 2 R , a smaller circular disc is cut with radius of the larger disc as its diameter. The centre of the hole is at a distance of R from the centre of the

original disc. The distance of the centre of mass of the remaining portion from the centre is:

Options:

A. $\frac{R}{3}$

B. $\frac{R}{4}$

C. $\frac{R}{6}$

D. $\frac{R}{2}$

Question 47

The ratio of specific heat capacities at constant pressure to that at constant volume for a given mass of a gas is $\frac{5}{2}$. If the percentage increase in volume of the gas while undergoing an adiabatic change is $\frac{3}{2}$, then the percentage decrease in pressure will be:

Options:

A. $\frac{15}{4}$

B. $\frac{3}{5}$

C. $\frac{4}{15}$

D. $\frac{5}{3}$

Question 48

A planet is 121 times heavier than moon and has a diameter 9 times that of moon. If the escape velocity on the planet is v, then the escape velocity on the moon will be:

Options:

A. $\frac{11v}{3}$

B. $\frac{33v}{8}$

C. $\frac{8v}{33}$

D. $\frac{3v}{11}$

Question 49

The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 1.24μ m is incident on it. The band gap (in eV) for the semiconductor is

Options:

A. 1 eV

B. 1.1 eV

C. 2.48 eV

D. 0.7 eV

Question 50

In a nuclear fusion reaction, two nuclei, A and B fuse to produce a nucleus C, releasing an amount of energy ΔE in the process. If the mass defects of the three nuclei are ΔM_A, ΔM_B and ΔM_C respectively, then which of the following relations is true? (c is the speed of light).

Options:

A. $\Delta M_A + \Delta M_B = \Delta M_C + \frac{\Delta E}{c^2}$

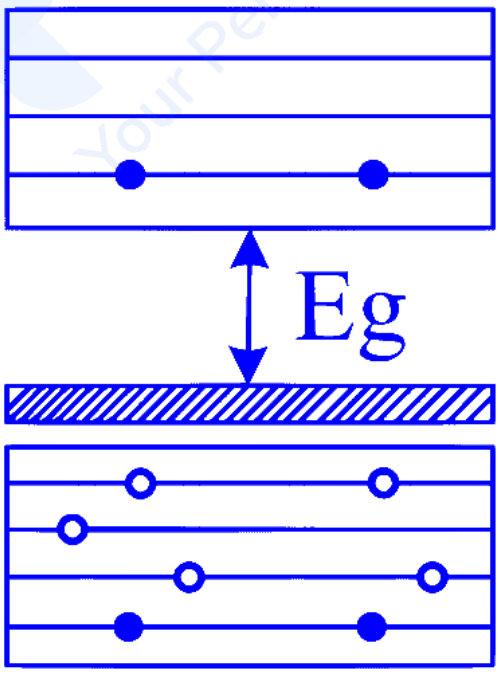
B. $\Delta M_A - \Delta M_B = \Delta M_C + \frac{\Delta E}{c^2}$

C. $\Delta M_A - \Delta M_B = \Delta M_C - \frac{\Delta E}{c^2}$

D. $\Delta M + \Delta M = \Delta M - \frac{\Delta E}{c^2}$

Question 51

In the energy band diagram of a material shown below, open circles and filled circles denote holes and electrons respectively. The material is a



Options:

A. metal

B. insulator

C. n-type semiconductor

D. p-type semiconductor

Question 52

A particle moves towards west with a velocity of $10\ \text{ms}^{-1}$. After 10s its direction changes towards south and it moves with the same velocity. The average acceleration of the particle is:

Options:

A. $2\sqrt{2}ms^{-2}NE$

B. $\left(\frac{1}{\sqrt{2}}\right)ms^{-2}SE$

C. $2ms^{-2}NE$

D. $\sqrt{2}ms^{-2}SE$

Question 53

The electric and magnetic fields associated with an electromagnetic wave propagating along +z axis, can be represented by

Options:

A. $E = E_0 i, \quad B = B_0 j$

B. $E = E_0 i, \quad B = B_0 k$

C. $E = E_0 k, \quad B = B_0 j$

D. $E = E_0 j, \quad B = B_0 k$

Question 54

A bar magnet is oscillating in the earth's magnetic field with a period T. When the length of the bar magnet is doubled and its mass is quadrupled, the time period is T_1. The ratio of T_1 to T is

Options:

A. 1 : 2

B. 4 : 1

C. 2 : 1

D. 1 : 4

Question 55

A cylindrical tank 0.5 m in radius, rests on a platform 1.5 m high. Initially the tank is filled with water to a height of 2.5 m . A small plug whose area is 10^{-4} m^2 is removed from an orifice located on the side of the tank at the bottom. The speed with which the water strikes the ground is: [Assume $g = 10$ ms^{-2}]

Options:

A. 7.07 ms^{-1}

B. 5.1 ms^{-1}

C. 5.47 ms^{-1}

D. 7.62 ms^{-1}

Question56

A long solenoid has 400 turns. When a current of 100 A is passed through it, the resulting magnetic flux linked with each turn of the solenoid is 4 mWb . The self-inductance of the solenoid is

Options:

A. 1.6 mH

B. 16 mH

C. 16 H

D. 0.16 mH

Question57

Which of the following is not true for a perfect conductor?

Options:

A. Electric field inside a conductor is zero

B. The electric field just outside a conductor is always perpendicular to the surface.

C. The surface of a conductor is an equipotential surface.

D. The charge carried by a conductor is always uniformly distributed over the surface of the conductor irrespective of the shape of the conductor.

Question58

Young's modulus of the material of wires X and Y are in the ratio 4:1 and the areas of cross sections of the wires X and Y are in the ratio $2:1$. If the same amount of load is a pplied to both the wires, the ratio of elongation produced i n the wires X and Y will be: (Assume length of the wires X and Y initially are the same)

Options:

A. $1:8$

B. $1:1$

C. $8:1$

D. $1:2$

Question59

A force of $-F\hat{i}$ acts at the origin of the coordinate system. The torque about the point $(0, 1, -1)$ is:

Options:

A. $F(\hat{j}+\hat{k})$

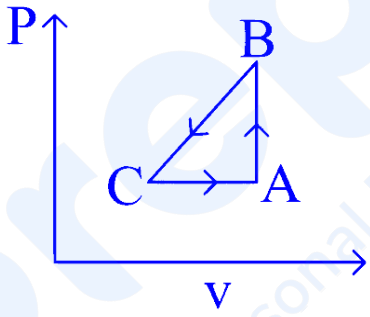
B. $-F(\hat{j}+k)$

C. $F(\hat{i}+k)$

D. $-F(\hat{i}+\hat{j})$

Question60

A sample of an ideal gas is taken through the cyclic process ABCA as shown in figure below. It absorbs 60 J of heat during the part AB and rejects 80 J of heat during CA . There is no heat exchanged during the process BC. A work of 40 J is done on the gas during the part BC . If the internal energy of the gas at A is 1450 J , then the work done by the gas during the part CA is:



Options:

A. **10J**

B. **20J**

C. **40J**

D. **30J**